Part 6

AQUATIC NEMATOCEROUS DIPTERA

BY OSKAR AUGUSTUS JOHANNSEN

In the following pages will be given an account of the life histories of a number of small flies, commonly known as black flies, (Simuliidae), mosquitos, (Culicidae), and midges, (Blepharoceridae and Chironomidae). The material on which this study is based was for the most part collected in the vicinity of Ithaca N. Y., though some of it came from Saranac Inn N. Y. and elsewhere. The larvae were collected by means of a small hand net from the ponds; or swept by means of a brush into a cloth "sag-net" from the surface of the rock on the bottom of the shallow creeks in the manner described by Professor Needham in United States National Museum bulletin 39, 1899, part O, page 5. The material thus collected was then transferred to the breeding cages. These cages for the pond-water larvae consist of small glass jars containing some water plants. For those forms that require rapidly flowing water a jar was used from which the water was drawn by means of a continuous siphon as rapidly as it entered.[1]

The material was collected during the summer of 1901, and studied during the fall of the same year in the entomological laboratory of Cornell University, under the direction of Prof. J. H. Comstock, to whom I wish to express my thanks for his advice in the preparation of this work. I also desire to acknowledge my obligation to Prof. J. G. Needham, of Lake Forest University, who suggested the work, directed its course and supplied me with material; to Professor Aldrich, of the University of Idaho, Professor Smith, of New Jersey, Professor Kellogg, of Leland Stanford Jr University and Messrs MacGillivray and Houghton for material from various localities.

The object of the paper is to give the distinctive generic and specific characters of larvae and pupae of the forms studied,

[1] See Comstock. Insect Life, p.330.

tabulated in the form of keys, to enable any one having an elementary knowledge of entomology to identify members of this interesting group of insects.

The Simuliidae are treated at greater length than the others, more material being at hand for the study of this family. In the descriptions of the wings of the adult, the nomenclature of Comstock and Needham (1898) has been followed.

The aquatic larvae of the Diptera may be distinguished from aquatic larvae of other insects by the absence of true, jointed thoracic legs; in having abdominal prolegs, or in being entirely legless; in the most degenerate forms the head is reduced and retracted within the pointed apex of the thorax, and no appendages of the imago are visible. Their pupae either have prominent prothoracic dorsal spiracles, often borne at the end of the antennaelike processes, or the pupa is formed in the hardened larval skin. The adults have but two wings, or in a few rare cases are apterous. The presence of the balancers and the absence of caudal filaments distinguish them from the males of the Coccidae. The most familiar examples are house flies and mosquitos.

The Diptera in general are divided into two suborders:

Larvae with a differentiated head; pupae free or inclosed in the larval skin; in either case the larval skin bursts for the extrication of the pupa or imago in a T-shaped opening on the back of the anterior end, or rarely in a transverse rent between the eighth and ninth abdominal rings. The imago lacks the frontal lunule and ptilinum. Examples are the gnats, midges, crane flies, horse flies, snipe flies, robber flies, etc. (Nematocera and Brachycera) ..... Orthorrhapha

Larvae without differentiated head; pupae always inclosed in the hardened larval skin (forming the so called puparium); the imago always escaping from the anterior end through a circular orifice. Frontal lunule present; ptilinum usually present. Examples of this suborder are flesh and horse flies, bots, drone flies, etc. Among these are but few having aquatic larvae—a few Syrphidae, some of the Sciomyzidae[1] and other Acalyptrate Muscids.... Cyclorrhapha

[1] See N. Y. State Mus. Bul. 47. 1901. p.577.

KEY TO FAMILIES OF NEMATOCEROUS DIPTERA

Larvae

1 Mandibles opposed, with the jaws moving in a horizontal plane; when the mouth parts are rudimentary, the larva has 13 segments and is peripneustic[1] (2).....Nematocera

Mandibles parallel, their motion in a vertical plane; if the motion is obliquely inward, then the head is not sharply differentiated from the first thoracic segment .....Brachycera

2 Larva with fully differentiated head, nonretractile, which contains the first ganglion and sometimes the eyes, peripneustic or amphipneustic,[2] with breathing tube or tracheal gills.....(3).....Tribe Eucephala

Larva with only a "jaw capsule" (Kiefer kapsel).....(14)

3 Terrestrial forms, living in the earth, in rubbish, under bark, or in fungi....(4)

Aquatic or semiaquatic.....(6)

4 Larvae without thoracic prolegs.....(5)

With thoracic prolegs. Living under bark.....Ceratopogon

5 Body bristly; head usually with eyes.....Bibionidae

Body not bristly, head usually without eyes .....Mycetophilidae

6 Prolegs at least on fourth and fifth segments (i. e. on first two abdominals) (7)

No prolegs on these segments.....(8)

7 Spiracles on the first and last segments, with tracheal gills, and a very long membranous breathing tube.....Ptychopterinae

No long respiratory tube; larva swimming in a U-shape.....Dixidae

8 Body flattened, onisciform, and usually with suckers underneath.....(9)

Body more or less cylindric, without suckers on the intermediate segments...(10)

9 The segments alternating small and large, the outline of the body, serrate. Living in rapid flowing streams.....Blepharoceridae

The segments gradually larger at the middle of the body, becoming smaller again toward the posterior end.....Psychodidae

10 With thoracic prolegs.....(13)

Without thoracic prolegs.....(11)

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[1] Spiracles confined to the median segments. The Chironomidae usually have jaws which move in oblique planes.

[2] Spiracles confined to the first and last segments.

11 Thorax enlarged; abdomen usually with long hairs; usually a complex respiratory apparatus at the anal end.....Culicidae
Body much elongated.....(12)
12 Last segment of the abdomen with two fleshy points.....Rhyphidae
Last segment tapering, often with a few long hairs. Body snakelike, segments of nearly uniform length. (Ceratopogon).....Chironomidae
13 With anal prolegs and blood gills. (Chironomus, Tanypus, etc.).....Chironomidae
Without anal prolegs; a broad abdomen, with a terminal sucker; head with a pair of fanlike organs (black flies).....Simuliidae
14 With rudimentary mouth parts; body with 13 segments; peripneustic (i. e. spiracles on the median segments). Gall gnats.....Cecidomyiidae
With biting jaws. Head incomplete, small, retractile, not containing nerve ganglia; 12 body segments; posterior stigmata usually with some fleshy filaments (crane flies).....Tipulidae

Pupae

1 Prothoracic spiracles, if present, borne on appendages (Nematocera).....(2)
Prothoracic spiracles sessile.....Brachycera
2 Nonaquatic. Leaf miners or gall makers (Cecidomyiidae); larvae living in fungi (Mycetophilidae); larvae living in the earth (Bibionidae); larvae living under bark (some Ceratopogon)
Aquatic or semiaquatic.....(3)
3 Pupae in a fibrous cocoon.....(4)
Without cocoon, sometimes in the old larval tube.....(5)
4 Cocoon cornucopialike, the coarse thoracic filaments of the pupa projecting. These filaments are usually few in number.....Simuliidae
Thoracic filaments of the pupa if present, entirely within the cocoon, the latter usually subcylindric.....Some Chironomidae
5 Body convex, hard shelled, and attached limpetlike to the rock.....(6)
Not attached nor limpetlike.....(7)
6 Shield-shaped, flattened. Thoracic breathing tubes are subcylindric[1].....Some Psychodidae

[1] See Professor Kellogg's paper in *Ent. News*, Feb. 1901.

Convex, oval; breathing tubes composed of several lamellae.....Blepharoceridae

7 Prothoracic respiratory appendages simple, slender, antennaelike; pupa sluggish or motionless.....(8)

Prothoracic appendages short and pointed, or club shaped, or composed of numerous fine filaments, or entirely wanting .....(9)

8 First abdominal segment about as long as those following it.....Some Psychodidae

First abdominal segment about half as long as those following it.....Tipulidae

9 Prothoracic appendages short and pointed.....Rhyphidae

These appendages not as above.....(10)

10 With two rounded paddlelike appendages at the caudal end.[1] Pupa active.....Culicidae

Without distinct paddles (if present, then pointed, and with ciliate margin)...(11)

11 The caudal end with two pointed processes and usually bent forward over the pectus; the pupa resting on its side.....Dixidae

Prothoracic appendages either many branched, simple or apparently wanting, the pupa in the larval tube (Chironomus) or active, Culexlike (Tanypus); or floating nearly motionless (Ceratopogon) .....Chironomidae

The above keys are modifications of those given by Mr C. A. Hart, Illinois State Lab. Nat. Hist. Bul. 1895. v.4, art.6, p.186-89.

To determine the imagines, the reader is referred to Comstock's *Manual for the Study of Insects*, or to Williston's *Manual of the North American Diptera.*

Family BLEPHAROCERIDAE

Net-winged midges

These flies are of moderate size, elongate and bare, with long legs and broad wings. The ocelli are present; the proboscis is elongated; the antennae are slender, composed of from six to 16 joints, clothed with short pubescence. The thorax has a distinct though interrupted suture. The empodium is very small and the pulvilli are wanting. The wings are broad, without hair, with a projecting anal angle; characterized by a network of fine lines which extend in various directions and not

[1] Corethrella (q. v.) is an exception: having two pointed caudal lobes.

influenced by the veins of the wing, though apparently constant in position in a given species.

The larvae live in running water. The head has a pair of slender antennae; the cephalothorax and the following segments each with a conical process bearing a bunch of bristles; pupa flattened, inactive and free, inclosed in a semioval shell-like skin, the anterior end with erect breathing tubes; on the underside the skin is soft and transparent.

Genus BLEPHAROCERA Macq.

This genus is distinguished from the other genera of this family, in that the eyes are holoptic (i. e. contiguous); bisected by an unfaceted cross band or by a single groove. The radius (Comst.) is three branched (i. e. the second longitudinal vein is not furcate); and the vein M_3 with its basal end free and beginning in the middle of the wing. See figure in Comstock's *Manual*, p. 433.

Blepharocera capitata Loew

Berl. Ent. Zeit. 1863. Centur. 4; p.43

So far, but one species of this family, Blepharocera capitata Loew, has been recorded from this State. It is very abundant in several of the ravines about Ithaca, and larvae have been found in other parts of the State. The first adults observed the past year, emerged about June 1, and they had all disappeared by July 15. The fact that their season of flight is a short one, and that they are found only near the water's edge in deep and comparatively inaccessible ravines, accounts for the scarcity of the species in collections. The life history of this species has already been given by Prof V. L. Kellogg in *Entomological News* for January 1900, p.305-18; and the imago has been described by Loew in the *Berliner Entomologische Zeitschrift*, 1863, p.43. The life history may be briefly stated as follows:

The eggs have not yet been discovered. The larvae may be found throughout the month of May, in shallow but swiftly flowing water. About Ithaca they have been found most fre-

quently in the little stream flowing through Coy glen, in Six Mile creek, and in Cascadilla creek; and have also been collected by Mr A. D. MacGillivray in a brook near Axton N. Y. During the early part of May the larvae are still quite small, the smallest found measured 2.5mm in length, and were scattered over the smooth rock bed of the stream where the water is swift, but only about 1 inch in depth. If removed from the brook and placed in vials or still water, they soon die, usually within a few hours.

The larva is a curious black creature, flattened, its length being about two and one half times its breadth at widest part, each of the four intermediate segments separated from each other and from the cephalic and anal portion by deep constrictions, thus dividing it into six distinct parts. Kellogg says (in the paper just quoted) that the anterior, apparently single segment is composed of the fused head and three thoracic segments, while the most posterior part is composed of the last two abdominal segments, the intervening parts representing each a single abdominal segment. The larva is footless, but each body part bears a pair of small unsegmented, pointed projections, situated on the ventral aspect of the lateral margins. The organs of locomotion consist of six suckers, one of which lies on the median ventral aspect of each body part; thus there is but one sucker for the combined head and thorax, and but one for the last two abdominal segments. By means of these suckers, the larva clings to the rock bed of the stream. The larva occasionally moves about on the smooth surface of the rock, from the necessity of getting farther into the stream as the water lessens in quantity, and perhaps also, for seeking its food—the diatoms on the surface of the rock. The structure of the sucker is well described by Kellogg (*loc. cit.*). The larvae breathe by means of small tufts of short thick tracheal gills, of which there is a pair on the ventral surface of each of the first to the fifth abdominal segments. On the last segment there are two pairs of much larger, thicker, fingerlike processes, perhaps also tracheal gills. The writer collected during May many liv-

ing larvae, and attempted to rear them, by placing them in aquaria of running water, but succeeded with only four specimens. The first of these cast its larval skin on May 20; the second on the 25th, the third on the 26th, and the fourth on the 27th. The casting of the larval skin is most rapidly accomplished. A larva in the breeding cage attracted attention because of its grayish color, not so black as usual, the pale color owing, probably, to the skin being loosened. A moment later, perhaps half a minute, the empty larval skin was seen floating away, leaving the cream-white pupa on precisely the same spot which had been occupied but a moment before by the larva. In the new pupa, the constrictions of the body so distinctive in the larva, were still plainly visible; within half an hour they began to disappear, and the color gradually became darker. In from three to four hours the pupa had assumed its characteristic shape, and the coal-black color. The four empty larval skins examined, all had a small irregular break on the ventral surface just cephalad of the first sucker, and another small T-shaped opening on the dorsal surface opposite the one on the ventral. The rest of the skin, including the suckers, remained intact.

The pupa is coal-black, heavily chitinized, and is shaped like the half of a longitudinally cut egg, though somewhat more flattened. At the anterior end is a pair of dorsal, prothoracic tracheal gills, each gill consisting of four flattened plates. The whole of the flat ventral surface of the pupa is fastened so firmly to the rock that it is practically impossible to remove it without breaking the shell. The length of pupal life is from 16½ to 18 days. If the pupae be taken from the water on the piece of rock to which they are attached, removed to the aquaria, and placed with the heads down stream, under a small stream of water, no difficulty will be experienced in rearing them. A number of specimens reared in this way were observed by the writer to emerge. From five to 15 minutes are required for the imago to free its body from the pupal skin, the wings remaining folded till the abdomen is

free, when suddenly they spread out fanlike and held above the surface of the shallow water, the legs all bunched up and still remaining in the pupal skin. The force of the flowing water and the struggles of the insect in from one to five minutes cause the legs to draw out, and, thus liberated, the imago immediately takes flight. In deeper water the wings probably do not unfold till after the insect is washed to the surface, though no observations were made upon this. Figures of larvae and pupae may be found in Comstock's *Manual*, and in Kellogg's papers in the *Entomological News* for 1900, and in Cal. Ac. Soc. Proc. 1903.

Family SIMULIIDAE

Black flies

In this family the body is short and stout; the legs are short; and the tibiae possess spurs. The antennae are scarcely longer than the head, cylindric and 10 jointed; the two basal joints are differentiated; the others are closely united. Proboscis not elongated, with small horny labella; palpi are four jointed. The thorax is much arched, giving the fly a humpbacked appearance; the scutellum is small; the abdomen is cylindric, composed of seven or eight segments; the legs strong and not elongate. The wings are broad, iridescent, and not clothed with hairs. The veins near the costal border are stout; those on the other parts of the wing are very weak. [*See* pl.34, fig. 1]

The larvae are soft skinned, not slender, usually more or less constricted in the middle. The head is cylindric, with eye spots on each side. The head bears two large fan-shaped organs, which aid in procuring the food. Respiration is accomplished by means of three blood gills which are pushed out from the dorsal surface of the last abdominal segment (Miall & Hammond say from the rectum). On the segment back of the head is a foot armed with hooks, and on the posterior end of the body is a disklike sucker by means of which the larva clings to the rocks or to plants. The creature moves about on the surface of the rocks with a looping gait similar to that of a measuring worm, and a web is secreted which prevents its being washed away by the swiftly flowing water.

The pupae are incased in cocoons which are firmly fixed to the rocks, these cocoons sometimes occurring in dense masses, forming a carpetlike covering on the rocks; in other species they occur separately or in small groups. The pupae, like the larvae, breathe by tracheal gills; but in this stage the gills are borne by the prothorax. The adult fly, on emerging from the pupa skin, rises to the surface of the water and takes flight at once. Soon after this the eggs are laid.

Bibliography of the biology of the Simuliidae

Barnard, W. S. The Black Fly in Ithaca N. Y. Am. Ent. 1880. 3:191

Brauer, F. S. ornata. Die Zweiflügler des Kais. Museums zu Wien. 1883

Comstock, J. H. Manual for the Study of Insects. 1895. p.451–53

Eichhorn. Naturges. d. Kleinsten Wasserthiere. Danzig. 1774. Tab.7

Fabricius, O. Tipula sericea. Beschr. d. Atlas Muecke u. ihrer Puppe. Schr. d. Berl. Ges. naturf. Fr. 1784. 5:254–59

Fries. Obs. entomol. Pars I. Monogr. Simuliarum Sveciae. 1824

Garman, H. A Silk-spinning Cave Larva. Science. 22–23:215–17

Graber. Die Insecten. Th. 2, 2:516

Hagen, H. Simulium sp. Ent. Monthly Mag. 19:254–55

——— S. pictipes. Bost. Soc. Nat. Hist. Proc. 1879. 20:305–7

——— On Simulium. Canadian Ent. 1882. p.50–151

Heeger. Beitr. zur. Naturgesch. der Kerfe. etc. Isis. 1848. p.328. Tab.4

Horvath. Le moucheron de Columbatch. Rovart. Lapok. 1 Bind. p.195–204

Howard, L. O. Note on Simulium Common at Ithaca N. Y. Insect Life. 1888. 1:99–101

Kellogg, V. L. Food of Larvae of Simuliidae and Blepharoceridae. Psyche. Feb. 1901

Koelliker. Obs. d. prima insectorum genesi, adjecta articulatorum evolutionis cum vertebratorum comparatione, p.11. Tab.2

Kollar. Ueber die Entstehung der Collumbatzer Muecken. Sitz. ber. d. k. Akad. d. Wiss. z. Wien. 1848. p.1–16

Lugger, O. S. tribulatum. (=S. vittatum Zett.) Univ. Minn. Agric. Exp. Sta. Bul. 48. 1896. p.205–7, fig. 147–49

McBride, Sara J. The so called Webworm of Young Trout. Am. Ent. 2:365

Meigen, J. Syst. Beschr. 1818 and 1830. v.1 and v.6 (p.309)

Meinert, Fr. De eucephale Myggelarver. 1886. p.90–96

——— S. fuscipes og reptans Trophi. Dipterorum. p.41–43. Taf.1

Metschnikow. Embr. Studien an Insecten. Zeit. f. wiss. Zool. 16:4–18. Tab.23

Needham, J. G. Simulium Society. N. Y. State Mus. Bul. 47:407–8. 1901. With plate 15

Osborn, H. Insects affecting Domestic Animals. U. S. Dep't Agric. Div. Ent. Bul. 5. n. s. 1896. p.31-58

Osten Sacken, C. R. On the Transformations of Simulium. Am. Ent. 2:229. With references

Planchon, J. E. Histoire d'une larva aquatique des genre Simulium. Montpellier. 1844. p.15

Pohl. (Pohl & Koller). "A Brazilian Pest," in Reise in das Innere von Brazil. 1832

Riley, C. V. The Death Web of Young Trout. Net of Simulium larvae. Am. Ent. 1870. 2:227–28

——— S. piscicidium. Am. Ent. 1870. p.366, 367

——— Simulium from Lake Superior. Am. Nat. 1881. 15:916

——— Buffalo Gnat Problem, abstract. Am. Ass'n Adv. Sci. Proc. for 1887. May 1888. 36:362

——— S. pecuarum and meridionale. U. S. Com. Agric. Rep't for 1886. 1887. p.459–592

Schiodte. S. fuscipes. Kvaegmyggen. Berlingske Tidende. May 16, 1878

Schönbauer. Geschichte der schaedlichen Kolumbatczer Mücken in Bannat. 1795

Theobald. Simulium Larvae. British Flies. p.166

Tomosvary, Edward. Im Auftrage d. K. ung. Minist. f. Ackerbau, etc. Uebers. v. Joh. Wieny. 1885

Townsend, C. H. T. On the Correlation of Habit in Nematocerous and Brachycerous Diptera, between Aquatic Larvae and Blood-sucking Adult Females. N. Y. Ent. Soc. Jour. 3:134, 136

——— On a species of Simulium from Grand Cañon of Colorado. Am. Ent. Soc. Trans. 1893. 20:45

Verdat, G. J. Mémoire pour servir a l'histoire des Simulies. Naturw. Anz. d. Schweiz. Ges. 1822

Webster, F. M. Report on the Buffalo Gnats. U. S. Dep't Agric. Div. Ent. Bul. 4. 1887. p.29

Weissmann. Ueber die Entstehung des vollendeten Insecten in Larve und Puppe, p.25–30, tab. 1, 2, 3

Westwood. The Water Cress Fly. Gardner's Chron. 1848. p.204

The life histories of some of the members of this family have long been known. Otto Fabricius in 1784[1] published an article, "Beschreibung der Atlasmücke und ihrer Puppe." A little later (1795) Schönbauer published his account of the immature stages of the Columbacz midge. He was the first to state that these earlier stages are passed in the water. In 1822 appeared Verdat's paper, on Simulium sericeum (=S. reptans, according to Schiner) in which he figures the pupa, the larva, together with enlarged details of the mouth parts of the latter. Among other early writings on life history may be mentioned Fries's

1 Schr. d. Berl. Ges. naturf. Fr. 5:254–59. tab.3, fig.1–5.

monograph, *Simuliar* (1824), Westwood's *The Water Cress Fly* (1848) and Heeger's *S. columbaschense* (1848). More recently there appeared in proceedings of the Royal Society of Copenhagen (1886) a very useful paper by Fr. Meinert on "De eucephale Myggelarver," of which six or seven pages are devoted to Simulium, besides some very good figures. On the early stages of American species, Riley, in the report of the United States entomologist for 1884, p. 342-43, writes as follows:

The early stages of several of the American species have been studied. In the *American Entomologist* [June 1870, 2:227] under the heading, "The Death Web of a Young Trout" we described the larva and pupa with figures of a species afterward described by us as S i m u l i u m p i s c i c i d i u m [*ibid*, p. 367]. These larvae were said by Seth Green to live attached to stones in swift running water and to spin a silken thread in which young fish became entangled and killed. This statement created much excitement among fish culturists at the time, and really seemed very plausible. It was contradicted, however, by Sara J. McBride, of Mumford N. Y., in an article published in the same volume [p.365-67], and also by Fred Mather of Honeoye Falls N. Y., in private correspondence with us. Mrs McBride found that the perfect flies issued about April 1, and June 1 thereafter the larvae were found in the streams in great numbers—as a general rule attached to water plants 3 or 4 inches below the surface of the water. Some were also attached to stones at the bottom. The majority were fastened to green decaying water cress, and these were green in color, while others which held to dead forest leaves of the previous year's growth, which had become entangled in the cress, were brown. From this fact she justly argued that they fed on decaying vegetable matter. There was a succession of generations or broods throughout the season, the development of a single brood occupying about two months. The flies issuing in midsummer were smaller than those developed in the spring and fall, although no difference in the size of larvae and pupae was perceptible. In the same volume (229–30), Osten Sacken gives an account of an undetermined species found attached to the roots and plants in swift running streams in the vicinity of Washington. This article contains also an able review of previous writings on the subject and is illustrated with figures taken from Verdat. In the *American Entomologist* [Aug. 1880, 3:191–93] Dr W. S. Barnard described the stages, with figures of the eggs, of a common species in the mountain streams around Ithaca N. Y. The eggs

were found on the rocks on the bank a few inches above the surface of the water; the newly hatched larvae were just at the surface, and from this point there was a regular gradation in the size of the larvae down into the stream. The eggs were found abundantly on June 1. In the proceedings of the Boston Society of Natural History for January 1880, Dr Hagen described Simulium pictipes, a remarkably large species, the larvae and pupae of which were found in the rapids of the Ausable river, Adirondack mountains; and in mentioning the fact in the *American Naturalist* for April 1881, we stated that the larvae and pupae of presumably the same species were found by Messrs Hubbard and Schwarz in the rapids of Michipicoten river, north shore of Lake Superior. The larvae were there found to have the peculiarity of floating in long strings, attached to each other by silken threads, while the pupae, found in the quieter pools close by, resembled coral. We also hazarded the statement that these were the immature forms of the celebrated black fly of the Lake Superior region. In reference to the probable identity of the Adirondack with the Lake Superior species, Dr Hagen, in comparison of the specimens of these larvae and pupae, received from Mr Hubbard, with similar stages of S. pictipes, remarked [*Canadian Entomologist*, 13:150–51] that, while the larvae and pupae did not differ materially, imagos from the Lake Superior, not raised from the pupae collected by Mr Hubbard, differed from S. pictipes in the much smaller size and in the color of the legs.

The report of the United States entomologist for 1886 contains detailed account of the life history of two species, the southern buffalo gnat and the turkey gnat. This paper is the most complete record we have of any species of Simulium in this country.

Economic importance. In the northern states the attacks of the black flies on domestic animals, though causing considerable loss to the stock raiser, is not of such a nature that accurate statistics can be obtained. Otto Lugger, late state entomologist of Minnesota, in his report of 1896, p. 201 and 203, says:

The losses caused by this insect are, in some years, very great, and the state of Tennessee alone lost in 1874 as much as $500,000. This southern buffalo gnat occurs as far north as Minneapolis, at least a few specimens have been found there. Here in Minnesota we have a number of other species of this family of flies, which cause more or less injury to our stock.

The first species seen and felt occurs early in the spring, soon after the snow disappears. It is a very small species, which flies with great force so that it can be felt when striking the face. It seems that it does not care much for human blood, but it irritates considerably by being of a very inquisitive nature, even entering the mouth, nose, ear and what is worse, the eye. If horses are left standing for some time in the roads, they are apt to become restive, shake their heads in a violent manner, frequently stamping and snorting at the same time. If the ears of the horse are inspected, we usually find the cause of their irritation in a large number of such small flies, which are busily engaged in sucking the blood, and they do so by inserting their powerful piercing organs into a vein, hence they seem to be arranged in regular rows. If not occuring in very great numbers, they cause but little harm, and an application of a little grease rubbed together with a few drops of carbolic acid, soon remedies the evil, and drives away other intruders. This species flies from May 15 to June 1, and very likely breeds in the Mississippi river near Minneapolis, though the earlier stages have, as yet, not been found. A little later in the season, but chiefly during June and July, a somewhat larger species (S i m u l i u m d e c o r u m Walker) becomes numerous. This species occurs sometimes in large numbers, but only females have been found thus far. This is of course easily explained by the fact that only the females of these flies are bloodthirsty; the males remain near the place of their birth, some running water, and, as they have only a rudimentary mouth, they could not imbibe blood, even if they were inclined to do so. This fly attacks, by preference, cows, and is sometimes found in such large numbers as to cause some injury to them. They are found most usually in the ears, and between the legs, or wherever the skin of the animal is thin and not well protected with hairs. Sometimes the cows suffer severely from their attacks, and, being constantly irritated by these small tormentors, they lose in flesh and give less milk. The front feet are in constant motion, a habit all species have, and are utilized more as feelers than as legs. This species is found active during the whole summer and autumn, but only in certain places, which can however be very far from the breeding places, and these insects must possess some very powerful sense to detect their victims such long distances.

The damage done in the South is described by Riley as follows:

As far as can be learned the damage in Louisiana was but slight prior to 1850; but many animals were killed in 1861, 1862,

1863, 1864 and 1866. In this latter year the parish of Tallulah La. lost over 200 head of mules, and upward of 400 mules and horses were killed within a few days in the parishes of Madison, Tensas, and Concordia, all in the same state. In other states they also did great damage. In 1868 many mules were killed in the lowlands of Davies county, Ky. Although frequently causing more or less trouble and loss, they did not appear again in such overwhelming numbers until 1872, 1873, 1874, 1881, 1882, 1884, 1885 and 1886. In 1872 it was reported that the loss of mules and horses in Crittenden county, Ark., exceeded the loss from all diseases. In 1873 they caused serious injury in many parishes in Louisiana. In 1874 the loss occasioned in one county in southwest Tennessee was estimated at $500,000. The gnats have been especially injurious since the Mississippi floods of 1881, and 1882; in the latter year they were more destructive to stock than ever before, appearing in immense numbers in eastern Kansas, western Tennessee and western Mississippi, and the great destruction of cattle, horses and mules caused by them added greatly to the distress of the inhabitants of these sections of the country caused by unprecedented floods. Many localities along the Mississippi river in Arkansas also suffered severely. In 1884 buffalo gnats appeared again in great numbers and were fully as destructive as in 1882. In Franklin parish, La., within a week of their first appearance, they had caused the death of 300 head of stock. They were equally numerous throughout the whole region infested, and for the first time in the history of the pest they attacked horses and mules on the streets of the cities of Vicksburg and Memphis. No general outbreak took place in 1885, yet gnats appeared in sufficient numbers to kill quite a number of mules in various parishes of Louisiana, especially in Tensas and Franklin. Buffalo gnats appeared again in immense numbers in 1886, and extended throughout the entire lower Mississippi valley, and swarms were even observed and doing damage far away from the region usually invaded. They came very late in the season, and consequently animals were in better condition to withstand their attacks. The damage was great however in many localities where planters had not taken steps to protect their stock. Besides the actual loss by death to their stock, planters lose much valuable time in preparing their fields for the crops. It so happens that the gnats appear at a time when the ground becomes fit to be prepared for cotton, and, as it is very important to give that plant as much time as possible to mature, every day is very valuable in early spring. Planters owning large estates have to use their mules for plowing, notwith-

standing the gnats, while farmers on a small scale can keep their animals in the stable, thus protecting them.[1]

Remedies and preventives

A number of remedies to counteract the poison of the buffalo gnats have been tried, but none of them have been sufficiently tested or have proved uniformly effective. The following applications have been of sufficient use to merit further trial: (1) Rubbing with water of ammonia, and administering internally a mixture of 40 to 50 grains of carbonate of ammonia to 1 pint of whisky, repeating the dose every three or four hours until relieved; (2) continued doses of whisky alone and keeping the animal in a cool and darkened stable; (3) immersion in cold water in running streams. Many cases of death of human beings from the bites of buffalo gnats have been reported, and some of them seem well authenticated. The painfulness of their attacks will certainly put people on their guard, but it would be well for persons in localities subject to their invasion to go prepared with some means of protecting themselves when far from shelter during the season of the year when the flies abound. The adults have so far appeared but little subject to attack from other animals. But few birds have been observed to feed upon them, though for the Southern forms the mocking bird, winter wren, and especially barnyard fowls, after the flies become gorged with blood feed upon them. Dragon flies, Libellulidae and robber flies, Asilidae, have been observed to catch them. The larvae are devoured in large numbers by the smaller fishes, minnows, etc., and probably the carnivorous beetle, bugs and other aquatic insects prey upon them. Dr Howard has observed in Washington the larvae of a species of Hydropsyche feeding upon the larvae of a species common in that locality. The pupae are pretty well protected by the resemblance in color to the objects to which they are fastened and their quiet habits. The eggs would seem to be open to the attacks of fishes, carnivorous beetles, etc., but no positive observations have been made. *Osborn*[2]

Very little can be done to destroy this insect in its earlier stages. The removal of obstructions in the rivers, which cause an acceleration of the motion of the water, would destroy some of their breeding places, but when there are so many this would make but little difference. Any chemicals to kill the larvae and pupae in the water would also kill fish, as they would have to be used very strong. The only way we have to protect ourselves

[1] U. S. Dep't Agric. Rep't. 1886. p.502.
[2] U. S. Dep't Agric. Div. Ent. 1896. Bul. 5, n. s. p.37, 38.

and our animals are repelling substances, such as stinking oils and smudges. A number of repellents are sold, and some of them are very good, for instance the "Black-fly cream," made in Portland Me. Our fishermen and hunters frequently use a mixture of kerosene oil and mutton tallow, with which the exposed parts are greased. For animals any of the strong smelling oils can be used, but repeated applications are apt to hurt them or to remove the hair. Oil of tar is a simple and easily applied wash. To make it, a quantity of coal tar is placed in a large shallow receptacle in which is stirred a small quantity of oil of tar, or oil of turpentine, or any similar material. After filling the receptacle with water it is kept undisturbed for several days, when the animals to be protected are washed with the impregnated water whenever necessary. Smudges are the best as a protection and the animals soon realize their protection and crowd to them for shelter, even refusing to leave them when needed elsewhere. As the black flies are active during the day only, and the mosquitos towards evening and night, dwellers in our northern woods have a bad time of it and sometimes suffer very greatly on their account. It is easy, however, to drive these tormenters from houses or tents. By burning inside of them a little Pyrethrum powder (Persian or Dalmatian insect powder) upon a piece of bark these intruders are either killed or so stupefied that they do not bite for some time. This method is in general use in the houses and stores of the Hudson Bay Company, and the writer has always used it successfully in his numerous trips. The fumes of the burning insect powder are not very offensive, at least not nearly so much so as the poisonous bites of such insects as black flies and mosquitos. *Lugger*[1]

Structural characters

There is but one genus of the family Simuliidae, Simulium, which possesses the characters of the family.

The eggs of the known species are deposited in a compact layer on the surface of rock over which water is flowing in situations as shown on plate 32. Their shape is elongate ellipsoidal, but they are usually closely packed with the long axis vertical and hence assume a polyhedral cross section. Eggs of the different species doubtless vary in size, those of the larger species (e. g. S. pictipes) measuring .40 by .18mm. In

[1] Minn. Agric. Exp. Sta. 1896. Bul. 48, p.207.

Hungary the eggs of S. columbatczense midge have also been studied. When first laid, they are enveloped in a yellowish white slime, which becomes darker, till, finally, it becomes black just before the emerging of the larva; the egg stage lasting about a week. For further notes on the eggs of Simulium see New York State Museum bulletin 47, 1901, page 408.

Larva. The larval stage of the known species lasts about four weeks in the summer, though longer in the cold weather. It is in this stage that it hibernates. Swift flowing water is essential to its life; if removed to quiet water, it dies within a day, and usually in a few hours. Fastened to the rock, twig or leaf by the anal end of the body, it assumes a more or less erect position and moves its head occasionally with a circling motion. It is able to move about on the surface of the rock or sides of the vessel in which it may be placed. Its manner of progression resembles that of the larva of a geometer moth, though not so rapid. Attaching itself by means of its thoracic proleg, it draws up its body in a loop, then, attaching itself by means of its caudal sucker, it releases the hold of its proleg. According to the unpublished observations of Miss R. Phillips (of the class of 1890, Cornell University), the larva feeds on algae, as Nothix, Cladophora, Vaucheria, on diatoms and parts of phanerogamous plants. Sand also has been found in the digestive canal.

Structure of the larva. The full grown larva of even the largest species does not exceed 15mm (about $\frac{5}{8}$ inch) in length. The body is somewhat cylindric in shape, enlarged at both ends, attenuated in the middle, the posterior half much stouter than the anterior part, and almost club-shaped [pl.34, fig.9]. Besides the head there are 12 poorly defined segments, the first two of which consolidate shortly before pupation. The color of the larva varies with the species, and perhaps also, to some extent, with the nature of its food. Some are a deep shining black, with paler incisures; others gray, yellow or dark green; in some the ventral surface is much lighter than the dorsal,

and in most of them the incisures are paler in color. On each side of the thorax is a triangular dark spot in the mature larva which marks the position of the developing tracheal gills of the pupa. The head is nearly quadrangular, a little longer than wide, dark brown or blackish in color, heavily chitinized, with two approximated irregular black eye spots on each side near the lateral margin.

The antennae are placed at the sides of the head toward the cephalic end, dorsad of and near the base of the fan. They are very slender, apparently three jointed, about one half as long as the width of the head. The first joint is twice as long as the others taken together, slender, flattened, and sometimes almost hyaline; cylindric at the articulation with the second. The second joint is very slender, cylindric. The third joint is a short pointed process at the apex of the second; and two similar processes are usually to be seen at the articulation of the first and second. The fans are placed laterally at the cephalic end of the head [pl.34, fig.7]. Each fan consists of from 30 to 60 scythe-shaped rays (variable with the species), cilitate on the inner side, with longer setae at regular intervals [pl.34, fig.7, 8]. Each ray is widened dorsoventrally on about its basal one fourth, and, when spread, presents the appearance of the arc of a circle extending over the width of the fan near the base. The rays of the fan are borne on stout peduncles, to which they are articulated. The fans seem to be used in sweeping food into the mouth of the larva. When closed, the tips of the rays come just to the oral opening. The rays are folded when the larva is disturbed, otherwise widespread. The mandibles are placed ventrad of the fans and move in a horizontal plane. They are elongate, rather stout, brown, nearly twice as long as wide, furnished with teeth on the inner side near the apex, from two to four large, black teeth at the apex, and from six to 15 paler colored teeth behind these, gradually decreasing in size, excepting that the last two are usually stouter and larger than those immediately preceding. The stout apical teeth are difficult to count because, lying in differ-

ent planes and covered by the hair, they are somewhat obscured. The mandible is furnished with a dense fringe of hairs extending over its apex, more or less overhanging the teeth. Near the base on the ventral side (the jaws moving in a horizontal plane) is a fan of hairs which projects mesad, at right angles to the long axis of the mandible. Ventrad and mesad of the mandible are the maxillae. The maxilla with its palpus projecting outwardly is shaped somewhat like a mitten, the palpus representing the thumb [pl.36, fig.2]. Several long fringes of hairs extending cephalad and mesad, cover the surface of the lacinia, among which is a single stout spurlike process. On the palpus are a few scattered bristles, at its base usually a small tuft of hairs, and its apex is provided with papillae. The chitinous labrum is a short, somewhat semicircular shaped piece overhanging the mouth, its plane being nearly perpendicular to the long axis of the larva. Externally it is stiffened by a T or Y shaped brace, the stem forming a longitudinal keel [pl.33, fig.11, and pl.36, fig.5]. Extending apically is a long fringe of hairs, and back of the suture, combed backward and outward, are long hairs. The apical margin is sometimes serrate. The hypopharynx, through which the silk thread passes, is a rather complex structure; it consists primarily of two flattened chitinized plates, connected by membrane, forming a flattened tube [pl.37, fig.2]. At the apical (cephalic) end of this is articulated a complex chitinous doubly arched segment with two fringes of long, coarse hairs. The ventral plate is somewhat quadrangular in shape, widened cephalad, with its anterior and posterior margins concave, and its lateral margins sinuous. On its anterior margin, apically, is a transverse chitinous comb [pl.36, fig.4]. The dorsal plate [pl.37, fig.2] is composed of two triangular pieces joined on the center line. On its apical (cephalic) edge is a transverse comb which projects cephalad and ventrad. This comb lies somewhat cephalad of the comb of the ventral plate. The dotted lines of plate 36, figure 4, mark the position of the dorsal plate. The ducts from the silk glands [pl.37, fig.2] pass up between the two plates, the

threads uniting as they pass between the combs of the dorsal and ventral plates. I believe the function of the upper plate to be a press for the silk thread. On each side, extending dorsad and caudad, is a chitinized, hornlike process. Only the fringe of hairs of the hypopharynx is visible when the larva is viewed from below, the rest being covered by the labium. The suture between the labium and the ventral surface of the head, indistinct in some species, seems entirely wanting in others, and therefore, the labium is immovable. The cephalic margin of the labium is furnished with regularly placed teeth; the arrangement of which, together with the number and arrangement of the setae on the ventral surface, furnishes some excellent specific characters. Since, in order to identify a species, it is necessary to dissect out the mouth parts, a few words in this connection will not be out of place here. If the specimen, either fresh or alcoholic, be placed on its side, and with a scalpel a frontal cut made through the head, passing just below the eye spots separating the dorsal from the ventral surface, then, placing the sections with the cut surface uppermost, the mouth parts may be readily picked out with a needle. In the ventral part will be found the maxillae, the hypopharynx and the labium. The hypopharynx lies very close to the labium and therefore requires some care to remove it. In the dorsal part will be found the fans, the labrum, and the mandibles. If the cut be made too far toward the dorsal surface, the mandibles will be attached to the ventral part, and the labrum will probably be destroyed, since it lies at right angles to the axis of the body, overhanging the mouth opening. The separate parts may then be dehydrated, cleared, and mounted on a glass slide.

The single thoracic proleg attached to the ventral surface of the first (or second?) segment is an elongate, truncate, conical process, at its extremity with a number of rows of hooks, similar to those found at the anal end, to be described later. The use of this proleg has already been mentioned. From a narrow, slitlike opening on the dorsal surface of the last segment of the body are projected the retractile, translucent,

respiratory filaments (blood gills). These are three branched, sometimes simple, often much lobed [pl.37, fig.9]. Caudad of these is a chitinized, X-shaped fold, the anterior branches extending cephalad and laterad for a short distance. At the caudal end, with its plane nearly at right angles to the longitudinal axis of the body, are concentric circles of tiny hooks, the center of the circle being hollowed out, suckerlike. The rows of hooks, though arranged in concentric circles, are also arranged radially, so that about 100 radii may be counted, each radius with from eight to 20 hooks (varying with the species, and perhaps also, with the age). The function of these hooks with the suckerlike disk is for attaching the larva to the rock or rubbish in the water, affording a very firm hold. In some species the circle is not quite complete, but is slightly open on the dorsal side. The larva possesses two silk glands, laterally placed, extending about three fourths the length of the body, then recurved, U-shaped, extending back to the thoracic segments. The outlets are the two ducts which lead into the hypopharynx [pl.37, fig.2]. The silk is used by the larva for attaching itself to the surface on which it rests, to prevent its being washed away by the rapid flowing water and to build its pupal case. According to observations made by Miss Phillips and recorded in her thesis (1890), the spinning of the cocoon of S. p i c t i p e s is described as follows:

"In spinning, the thread issues from the mouth and is placed in the different positions by the thoracic proleg. The head is bent down, and with the proleg the thread is drawn around the body and other threads placed or twisted in all directions, until a very irregular network is formed, covering the whole of the body, except the head. The skin of the head is then cast off, and the insect pulls itself out of the skin of the body, leaving it whole. The cast skin may often be found in the cocoon, with the pupa. The cocoons are commenced at the upper margin and spun continuously down to the caudal end, where several threads are drawn from the cocoon and attached to the last one or two of the body segments of the pupa. The threads hold

the pupa very firmly and are always found when the pupa is pulled out of its case. Spinning is rarely seen excepting when the insect is in a stream of running water."

The pupal cases are usually composed of a rough, tough, clothlike fabric, and vary in shape with the different species. Three types of cases are known to me. One is shaped like a shoe, entirely concealing the pupa [pl.35, fig.5]. This is sometimes slightly modified, the heel being less prominent, and the instep disappearing, i. e. shaped like a flattened cylinder, the planes of the bases being parallel, but oblique (S. pictipes, and in a California species). Another, the most common type, is like that of a wall pocket, the head and the thoracic filaments projecting.[1] The third type is structureless, composed of a matted mass of thread on the rock, sometimes only partly covering the pupa; as in S. hirtipes. Large numbers of pupal cases are frequently found matted together, carpetlike. The pupa are generally of a pale or golden brown color, the abdomen being somewhat darker. The eyes of the adult soon become visible, as also the legs and wing cases. Eight body segments are visible from the dorsal surface, not counting the anal. The respiratory filaments arise from a single stalk on each side; this stalk has a variable number of branches, which again subdivide into twigs. The number of twigs is constant for a given species, ranging from four (in a European species) to upward of 60 in one of our own. For a description of their structure see a paper by Dr Volger, *Die Tracheen Kiemen der Simulien Puppen.*

On the segments are a number of small, regularly arranged black hooks, by which the pupa is attached to the fibers of its case. The arrangement of these hooks appears to be uniform for a given species. The pupal stage lasts about a week, sometimes a little longer. The adult makes its escape from the pupal skin through a longitudinal rent on the dorsum of the

[1] See Riley's figure of pupal case in U. S. Dep't Agric. An. Rep't 1886, of S. meridionale, or U. S. Dep't Agric. Div. Ent. Bul. 5, n. s. 1896. p.53.

thorax, leaving the skin, together with the respiratory filaments, otherwise intact.

The generic characters of the imagos have already been given in sufficient detail in the characters of the family; to which need only be added that the tarsal claws of the male in all the species I have examined are trifid; those of the female being either simple or bifid. All the tibiae are provided with spurs, in a few species only are those of the fore legs rudimentary. The middle and hind metatarsi possess a more or less regular row of spines on the extensor margin, which are wanting on the fore metatarsi. On the second joint of the hind metatarsus at its articulation with the first, there is usually a leaflike appendage covering the base of the flexor surface [pl.38, fig. 1, 8, 9].

List of the North American species of Simuliidae, genus Simulium

Latreille, Hist. Nat. Crust. et Ins. 1804. 14:294.

1*argus Williston, N. Am. Fauna, no. 7. May 1893. p.253. Cal. (Syn. of S. v i t t a t u m Zett. according to Coquillett, Harriman Exp. 1900. p.393).

argyropeza. See r e p t a n s .

*bracteatum Coquillett, U. S. Dep't Agric. Div. Ent. Bul. 10, n. s. 1898. p.69. Mass., Cal., N. Y., Kan., Mich.

calceatum Harris. A catalogue name according to Riley. Am. Ent. 1870. p.467.

cincta. See r e p t a n s .

*cinereum Bellardi, Saggio di ditterologia Messicana. 1:13. Cal. (Townsend, Baja, etc. 1893). Mex. (Bellardi).

columbatchensis Fabricius nec Schönbauer. See r e p t a n s .

decorum Walker. List of Dipterous Insects, etc. pt1. 1848. p.112. Hudson Bay Ter. (Syn. of S. v i t t a t u m Zetterstedt, according to Coquillett, n. s. Bul. 10, 1898. p.68).

elegans. See r e p t a n s .

erythrocephala. See r e p t a n s .

*fulvum Coquillett. U. S. Nat. Museum Proc. 1902. 25:96; 1898 o c h r a c e u m Coq. not Walk. Mont.; Id.; Col.; N. M.; Alaska.

*glaucum Coquillett. U. S. Nat. Museum Proc. 1902. 25:97. Missouri.

*griseum Coquillett. U. S. Dep't Agric. Div. Ent. Bul. 10, n. s. 1898. p.69. Col.

*hirtipes Fries, Obs. Entomol. Pars. Monogr. Simuliar. 1824. p.17, 5. Tfl. 1, f.1. N. Y., Id., Cal.

The following synonymy is according to Schiner:

1830 r u f i p e s Meigen, Syst. Beschr. 6:311-17.

1830 h i r t i p e s Fries, Meigen, Syst. Bescher. 6:312-18.

1850 h i r t i p e s Fries, Zetterstedt, Dipt. Scand. 9:3426-28.

[1]Those names to which a * is prefixed I consider either a distinct species, or not sufficiently described to warrant placing as the synonym of another.

innoxium Comstock. See S. p i c t i p e s Hagen.

***invenustum** Walker, List of Dipterous Insects, etc. 1848. p.112. Hudson Bay Ter.

(p e c u a r u m Riley is a synonym of this, according to Coquillett, 1898).

***irritatum** Lugger. Figured but not described in Univ. Minn. Agric. Exp. Sta. Bul. 1896. p.203.

***meridionale** Riley, Dep't Agric. An. Rep't for 1886. 1887. p.512.

1891 o c c i d e n t a l e Townsend, Psyche, July 1891. p.107. Mass., Miss., Neb., Tex. (synonymy and localities according to Coquillett, Bul. 10, n. s. 1898), N. J. (Johnson), Kans. and Id.

***metallicum** Bellardi, Saggio di ditterologia Messicana. 1859. 1:14. Mex.

***mexicanum** Bellardi, Saggio di ditterologia Messicana, Appendix 6. 1862. Mex.

minutum Lugger, Minn. Agric. Exp. Sta. Bul. 1896. p.202. Minn. (Figured but not described). See v i t t a t u m .

molestum Harris. See v e n u s t u m .

novicum Harris, Ins. Inj. to Veg. p.601. This is a Ceratopogon.

occidentale Townsend. See m e r i d i o n a l e .

***ochraceum** Walker, Ent. Soc. London. Trans. n. s. 3:332. Mex.

***pecuarum** Riley (Synonym of i n v e n u s t u m according to Coquillett).

1887 p e c u a r u m Riley, U. S. Dep't Agric. Rep't for 1886. p.512. N. H., N. Y., Mass., Ct., D. C., Mich., Miss., La. (synonymy and localities according to Coquillett, U. S. Dep't Agric. Bul. 10, n. s. 1898), N. J. (Johnson).

***pictipes** Hagen, Bost. Soc. Nat. Hist. Proc. 1880. 20:305. N. Y., Tex., Cal. (Coquillett, 1898) Id.

1895 i n n o x i u m Comstock. Name given in Manual for the Study of Insects.

piscicidium Riley. See v e n u s t u m .

posticata Meigen. See r e p t a n s .

***pulchrum** Philippi, Chilian Diptera. 1865. p.633. S. Am. and St Vincent, W. I.

1896 t a r s a l e Williston, Diptera of St Vincent, W. I. p.268. Synonymy according to Hunter, Catalogue of S. Am. Diptera. 1900.

***quadrivittatum** Loew, Berl. Ent. Zeit. 1862. Centur. 2, p.2. Cuba.

***reptans** Linnaeus, Fauna Suec. 1893. Europe, Greenland (Lundbeck, 1898). 1761.

Synonymy according to Schiner:

1767 s e r i c e a Linnaeus, Syst. Nat. 12:978, 58

1776 e r y t h r o c e p h a l a DeGeer, Ins. 6:161, 37 (Tipula)

1781 r e p t a n s L. Schrank, Enum. Ins. Austr, p.985 (Culex)

1787 c o l o m b a t c h e n s i s Fabricius, Mantissa Ins. 2:333 (Rhagio)

1804 a r g y r o p e z a Meigen, Classif. 1:96

1818 r e p t a n s Meigen, Syst. Beschr. 1:291-92

1818 s e r i c e a Meigen, Syst. Beschr. 1:296-98

1818 e l e g a n s Meigen, Syst. Beschr. 1:296-99

1818 v a r i e g a t a Meigen, Syst. Beschr. 1:292-93

1823 r e p t a n s Fries, Obs. Entomol. Pars 1 Monogr. Simuliar, p.13

1830 c i n c t a Meigen, Syst. Beschr. 6:311, 14

1838 p o s t i c a t a Meigen, Syst. Beschr. 7:52, 21

rufipes Meigen. See h i r t i p e s.
sericea Linnaeus. See r e p t a n s.
***tamaulipense** Townsend, N. Y. Ent. Soc. Jour. 1898. v.7. Tex.
tarsale Williston. See p u l c h r u m Phillipi.
tribulatum Lugger, Minn. Agric. Exp. Sta. Rep't 1896. p.205-7. Probably equals v i t t a t u m. (p.385. Seq.)
(Figured but not described)
***venustum** Say, Acad. Nat. Sci. Phil. Jour. 3:28; Compl. Wr. 2:51
Wiedemann, Auss. zw. Ins. 1:71. Ohio, D. C. (Osten Sacken, catalogue). N. J. (Johnson); Can., N. H., N. Y., Mich., Minn., Wyo., B. C., Cal., Tex., La., Miss., Fla., (Coquillett); Id. The following synonymy is according to Coquillett. 1898.
1862 m o l e s t u m Harris, Ins. Inj. to Vegetation. (Not described)
1870 p i s c i c i d i u m Riley, Am. Ent. 2:367. Mumford N. Y.
***virgatum** Coquillett, U. S. Nat. Mus. Proc. 1902. 25:97. New Mexico.
***vittatum** Zetterstedt, Ins. Lapponica. 1840. p.803. Staeger Groenl. Antl. Greenland (Osten Sacken's catalogue); N. J. (Johnson); Alas. (Coquillett 1900); Cal., Kan., Minn., N. Y., Neb. (Coquillett 1898), Id., S. Dak. The following synonymy according to Coquillett.
1848 d e c o r u m Walker, List. Ins. p.112. Hudson Bay Ter.
1893 a r g u s Williston, N. Am. Fauna, no. 7, p.253. Cal.

KEY TO SPECIES OF SIMULIUM

Larvae

1 Mature larva 6 or 7mm long, with the dorsal surface of the head nearly white; the rays of the fan number about 30. Larva from Santa Cruz mountains, Cal. [p.387].
Head usually brown; rays of the fan usually 40 or more.....(2)
2 The top of the head with six black blotches or spots. Larvae from New Mexico [p.386].
Head without six dark spots.....(3)
3 The caudal blood gills are three simple papillae.....(4)
The three main branches are again subdivided.....(6)
4 The middle tooth of the labium is simple and pointed, labium with six pairs of setae on its ventral surface [pl.35, fig.2].v i t t a t u m
The middle tooth at least is trifid.....(5)
5 All marginal teeth of the labium except the outer pair are trifid .....h i r t i p e s
The middle tooth only is trifid; ventral surface with three pairs of setae [pl.33, fig.8].....p e c u a r u m (=i n v e n u s t u m)
6 Full grown larvae 10-12mm in length, black in color, its labium with an elongate middle tooth [pl.36, fig.3].....p i c t i p e s
Paler larvae less than 10mm in length.....(7)
7 No setae on the last joint of the maxillary palpus, middle tooth of the labium longer than the two lateral ones, four pairs of setae on its ventral surface. The pair of apical setae of the mandible not differentiated from the hairs which overhang the apex.....m e r i d i o n a l e

Mandible with a pair of apical bristles, palpus of the maxilla with setae .....(8)
8 Middle tooth of the labium enlarged, ventral surface of labium with five pairs of setae [pl.37, fig.6].....venustum
Middle tooth not enlarged (varieties of venustum).....(9)
9 Labium with four pairs of ventral setae [pl.37, fig.14].....var. a
With seven pairs of setae [fig.5].....var. piscicidium

Pupae

(Arranged according to the number of filaments in each respiratory tuft)
1 With six filaments
a Legs in their cases appear bicolored[1].....venustum
b Legs unicolored.....meridionale
2 With eight filaments
a Pupa 4.5mm long; Arizona species. Pupa described in Am. Ent. Soc. Trans. p.45. 1893.
b Less than 4mm long; eastern species.....venustum, var. piscicidium
3 With nine filaments. Pupal case like that on pl.35, fig.5...pictipes
4 With 10 filaments.....var. a of venustum
5 With 12 filaments. Pupal case [pl.35, fig.5]. From Santa Cruz mountains, Cal. [p.387]
6 With 16 filaments.....vittatum
7 With 24 to 48 filaments [pl.33, fig.10].....pecuarum
8 With 60 or more filaments.....hirtipes

Imagines

1 Ground color of the thorax and abdomen deep yellow.....(2)
Gray or black; its hairs may be pale.....(3)
2 "Femora with black tip, length of fly 2mm." Mexico..ochraceum
"Femora without black tips. Length 3 to 4.5mm. Rocky mountains" .....fulvum
3 Hind tarsi with its basal joint partly yellow; legs bicolored .....(9)
Hind tarsi unicolored[2].....(4)
4 Halteres dusky; thorax not striped.....(5)
Halteres white or yellow; the female with striped thorax and bifid tarsal claws.....(6)
5 Body black; the female with dense yellow pile, her tarsal claws simple; the male with dense hair on the legs, his tarsal claws trifid. The wing with its radius three branched. Length 3 to 4.5mm.....hirtipes
"Body gray, legs reddish gray, feet black; length 3mm." This is said by Mr Coquillett to be the same as pecuarum Riley .....invenustum
6 Males, eyes contiguous.....(7)
Females, eyes separated by a distinct line.....(8)

[1] In order to see this it will be necessary to examine nearly mature specimens and perhaps to draw them from their pupal skins.
[2] The male of pictipes sometimes has legs nearly unicolored; it is however included in the preceding section.

7 Thorax velvety black; legs reddish with black tarsi. Length 1.5 to 2mm. Compare here also bracteatum (male), "with legs wholly brown."..... meridionale
Thorax brownish black; legs usually pale; tip of tarsi not black. Length from 2 to 4mm..... pecuarum
8 Thorax with silvery white pubescence; legs brownish black, covered with whitish hairs. A small variety (less than 2mm long), from New Mexico has been named occidentale Town. (q. v.)..... meridionale
Thorax with yellow hairs; legs reddish brown, covered with yellow hair; tip of tarsi blackish..... pecuarum
9 Males, eyes contiguous..... (10)
Females, eyes separated..... (20)
10 "Mesonotum wholly velvet black; gray spot on sides of the second, fifth, sixth, and seventh segments of abdomen. Length 1.5mm." ..... bracteatum
Metanotum striped, or with grayish or metallic reflections..... (11)
11 Dorsum of thorax with one or more longitudinal stripes..... (12)
Dorsum unstriped ..... (14)
12 Thorax with four longitudinal stripes; posterior margin white; abdomen black. Sex not given. Cuban species.... quadrivittatum
Thorax not so marked..... (13)
13 Front and middle femora and tibiae wholly yellow; center of mesonotum with a black vitta, elsewhere gray. Length 1.5mm. Colorado species ..... griseum
Femora and tibiae wholly or partly brown..... (13a)
13a "Femora and front tibiae yellow, their apices brown; middle tibiae brown, a yellow ring beyond the base, hind tibiae brown, the extreme base yellowish. Mesonotum marked with a narrow median and laterally with a very broad velvet black fascia." Length 3mm. New Mexico..... virgatum
Front femora brown, tibiae brown on apical part..... (13b)
13b Mesonotum with two narrow gray stripes (sometimes quite indistinct) on a velvet black ground, in which there are scattered golden hairs..... vittatum
"Mesonotum marked with a narrow median and slightly wider lateral black vittae." Length 2.5mm. Missouri..glaucum
14 Anterior femora yellow. Mexican species..... (15)
Anterior femora black..... (17)
15 Abdomen with the base of the second segment, and the sides of the third, fourth, and fifth yellowish white; tibiae fuscous black with yellow bases. Length 4mm..... mexicanum
Abdomen black ..... (16)
16 Metallic bluish black species; middle portion of fore tibiae, base of middle and hind tibiae, base of first and second joints of middle and hind tarsi, whitish. Length 2mm... metallicum
Thorax fuscous and cinereous pollinose; the humeri pallid, fore coxae pale, middle and hind ones dark; femora pale at the base, black at the tip; tibiae black. Length 3mm..cinereum

17 An oblique metallic streak extending inward from each humerus; posterior part of the thorax metallic. Length 2 to 2.5mm.....venustum
Humeral spots not metallic.....(18)
18 Anterior coxae yellow; long hair on femora and hind tibiae; thorax velvet black with white pruinose margin (Greenland).....reptans
Anterior coxae black.....(19)
19 Thorax velvet black, with oblique cinereous humeral spots, and usually two tiny metallic spots between them. Length 3 to 4mm.....pictipes
Thorax velvety black with two very narrow gray stripes and posterior margin; hind tibiae usually yellow at the base, hair on legs sparse.....vittatum
20 Thorax striped.....(21)
Thorax without stripes.....(25)
21 Dorsum of thorax with four longitudinal lines, posterior margin, white pollinose; abdomen opaque black. Cuban species.....quadrivittatum
Not with four stripes.....(22)
22 Dorsum of the thorax with five stripes, the outer ones spot-like, the intermediate ones clubbed at the ends; abdomen with black fascia on each segment, produced posteriorly at the middle and the ends. Sometimes the last few segments have only three or five spots.....vittatum
Thorax with one or three stripes.....(23)
23 With three stripes.....(24)
"With an indication of a darker median vitta" [*see* 31].....griseum
24 Small species, length about 1.5mm. "Abdomen silvery, third and fourth segments wholly brownish, sometimes with a median spot on each; legs yellowish, tarsi blackish or brownish." Species from Texas.....tamaulipense
Larger species 3mm. or more in length.....(24a)
24a Middle tibiae brown with a yellow ring beyond the base; vittae of mesonotum brownish, the median vitta dilated posteriorly, wider than either of the lateral ones. New Mexico.....virgatum
Femora and tibiae grayish, sometimes quite pale, tips of tibiae black. Laterodorsal thoracic stripes clubbed at the anterior end. Third, fourth, fifth, and part of sixth and seventh abdominal segments with velvet black fasciae; center of 6, 7, and 8, grayish or dull brown.....pictipes
25 Abdomen without distinct black spots.....(26)
Abdomen spotted.....(31)
26 Abdomen black, covered with long yellow pile; legs yellow, the tips of the femora and tibiae, and all the tarsi except basal two thirds of the hind metatarsi, brown.....bracteatum
Abdomen nearly bare.....(27)
27 Body gray or cinereous.....(28)
Body brown or black.....(29)

28 "Body gray with a white milky luster, specially the pleura and pectus. Legs tawny, femora and tibiae with irregular piceous bands, tarsi piceous. Length 2.5mm. Hudson Bay Ter." This is a synonym of vittatum Zett. according to Mr Coquillett (1898).....decorum

Thorax fuscous or cinereous pollinose, humeri pallid, pleura pale cinereous, scutellum pale at the tip; abdomen blackish; fore coxae pale, middle and hind ones cinereous; femora pale at the base, black at tip; tibiae black. Length 3mm. Mexican species.....cinereum

29 Abdomen somewhat shining, yellowish gray or whitish at the sides, and yellow at the base; legs brown, tibiae and fore coxae white, tip of tibiae and all tarsi black. European species, also occurring in Greenland.....reptans

Basal segments of abdomen opaque, distal four segments somewhat shining black or brown. Two long hairs at the tip of the first and third fore tarsal joints.....(30)

30 Legs reddish yellow, tarsi black, except proximal half of middle and hind metatarsi which are light yellow. Length 2mm. (St Vincent island) This is a synonym of pulchrum Phil. according to Hunter.....tarsale

Legs black, base of tibiae, first joint of middle and hind tarsi and sometimes base of femora yellow; extensor surface of all the tibiae more or less whitish. A widely distributed and variable species.....venustum

31 Length 1.5mm. Front and middle femora and tibiae wholly yellow; hind ones, except apices, also yellow. (Colorado).griseum

Length 2.5mm. Legs brownish black, distal part of femora, base of tibia, and greater part of metatarsi light yellow. (California).....argus

Some of the characters used in this table have been taken from the key given in United States Department of Agriculture, division of entomology, bulletin 10, new series, 1898, page 68, by Mr Coquillett. In the table given above, I have included all the North American species. For the southwestern and Mexican species it should however be used with caution as I did not have specimens of some of these.

Descriptions of the species

S. argus Williston

N. Am. Fauna, No. 7. May 1893. p.253. Cal. (Syn. of S. vittatum Zett. according to Coquillett, Harriman Exp. 1900. p.393)

Female. Black, the legs in part light yellow; front black, opaque; face cinereous, with whitish pubescence; antennae brownish black, the basal joint yellowish; thorax black, the

dorsum thinly pollinose; not shining; pleura densely white pollinose with a black spot; abdomen opaque velvety black, the first three segments with a narrow silvery white spot on either side at the hind margin, the next three segments similarly marked, but the interval between the spots successively wider, and each with two other, successively larger, white spots, leaving a black space in the middle and a narrower one at the outer sides; venter white; legs brownish black, the distal part of the femora, base of tibiae, and the greater part of metatarsi light yellow; wings pure hyaline, the veins light colored, those posteriorly very delicate. Length 2.5mm.

One specimen, Argus mountains, Cal. May 1891.

[1]Coquillett makes this a synonym of v i t t a t u m Zett., though nothing is said above of the handsomely marked thorax so conspicuous in the female of v i t t a t u m.

S. bracteatum Coquillett

Dep't Agric. Div. Ent. Bul. 10, n. s. 1898. p.69. Mass., Cal., N. Y., Kan., Mich.

Female. Dorsum of abdomen deep black, not marked with gray, quite densely clothed with nearly erect yellowish tomentum; mesonotum also deep black and covered with appressed golden yellow tomentum; pleura grayish black; legs nearly bare, yellow, apexes of femora and of tibiae, and whole of tarsi except the basal five sixths of the first joint of the hind ones on brown; first joint of front tarsi scarcely dilated, the first joint of the hind ones one half as wide as their tibiae; head gray, covered with a pale yellow tomentum; antennae black, the two basal joints yellow, mouth parts black; wings hyaline, costal, first three veins and first section of the fourth, yellow, the remainder subhyaline. Length 1.5mm.

Cambridge Mass. (May 31, 1889) and Los Angeles county, Cal. Two females, the one from California captured by the writer.

Male. Mesonotum wholly velvet black; abdomen with a gray spot on the sides of the second, fifth, sixth and seventh segments; legs almost wholly brown, otherwise as in the female. Two male specimens taken with the female.

Some female specimens believed to be this species received from Professor Aldrich, and a single specimen caught on a window in Ithaca, Oct. 16, by the writer agree perfectly with Mr Coquillett's description excepting that the abdomen of these

[1]Wash. Acad. Sci. "Harriman Exp." 1900. p.393.

specimens has two longitudinal rows of small spots which are not covered by the yellow tomentum. This was particularly noticeable in the fresh specimen, but, as drying caused shrinkage of the abdomen, the spots are no longer so distinct.

The fore tibiae are each provided with a single spur, the middle and hind ones each with a pair. The tarsal claws are each provided with a large basal tooth or lobe [pl.38, fig.15]. The halteres are pale yellow.

Cambridge Mass. and Los Angeles Cal. (Coquillett, 1898); Lawrence Kan. and Battle Creek Mich. (Collected by Professor Aldrich); Ithaca N. Y.

S. cinereum Bellardi

Saggio di ditterologia Messiana. 1859. 1:13

Male and female. Gray, antennae black, first joint pale. Thorax fuscous and gray pollinose, the humeri pale; pleura light gray; scutellum pale at the tip; halteres white. Abdomen blackish. The front coxae pale, the middle and hind pair grayish brown; the femora pale at the base, their tips black; tibiae black, their middle section pale; front tarsi wholly black, the middle and hind pair with the bases of first and second joints pale. Wings hyaline. Length of body 3mm; with extended wings 9mm.

Mexico, California (Townsend, 1893).

S. decorum Walker

List of Diptera. Brit. Mus. 1848. p.112

Cinereum, argenteo micans, antennis piceis, pedibus fulvis, femoribus tibiisque picco fasciatis, tibiis posticis tarsisque posterioribus basi albis, alis limpidis. Body gray, adorned with white milky luster, specially on the sides of the chest and on the breast; feelers piceous; legs tawny; thighs and shanks with irregular piceous bands; feet piceous; fore thighs adorned with white luster; hind shanks and four hinder feet white at the base; wings colorless; fore border veins pale tawny; the other veins still paler and very indistinct; poisers pale yellow. Length of the body 2.5mm; of the wings 6.5mm.

St Martin's falls, Albany river, Hudson bay. Presented by Mr G. Barnston.

According to Mr Coquillett,[1] d e c o r u m is a synonym of S. v i t t a t u m Zett.

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[1] U. S. Dep't Agric. Bul. 10, n. s. 1898.

In the report of the Minnesota Experiment Station, Bulletin 48, 1896, page 202, is given a figure of a female fly which is said to be S. decorum. In this figure the thorax is represented as unicolored, the abdomen with the anterior half of the second segment, a semicircular spot on the anterior margin of the segments 3, 4 and 5, a blotch on the sixth, and all of the remaining segments dark; legs dark, excepting the middle section of all the tibiae, a part of the middle and hind femora, and the basal two thirds of the hind metatarsi. No description is given, but the author stated that this fly occurs in large numbers in Minnesota during June and July. Some specimens kindly lent by Mr Washburn from the Minnesota Experiment Station Collection, bearing the label S. decorum proved to be S. vittatum (♀).

S. fulvum Coquillett

U. S. Nat. Mus. Proc. 25:96

Eight female specimens received from Professor Aldrich of Moscow Id. which I have examined, agree pretty well with Walker's description of ochraceum, excepting that in no case is there a trace of black at tip of femora, the tarsi are only slightly darker than the tibiae, and not black, and the length, which according to Walker is 2mm, is nearly double that in these specimens. The description of the Idaho specimens is as follows:

Deep yellow or ochraceous; the head, upper surface of antennae particularly at the incisures and the two basal joints, the mouth parts, sides of thorax at the base of the wing, the abdomen except the basal segments the tips of the tibiae and all the tarsi, particularly the fore and middle pair, and their flexor surfaces, and the hind metatarsi, more dusky than elsewhere. In fact, in some specimens the tarsi and the abdomen may be described as blackish. The head, dorsum of thorax and abdomen are covered with short, sparse, pale yellowish pile. Legs are without long hair; all tibiae with spurs; the tarsal claws simple. Halteres dusky yellow. Wings hyaline, slightly blackish at tip, subcostal cell yellow, the veins yellow except the apical half of the veins of the anterior margin, which are blackish. A yellow cloud follows the course of the media and the anal veins, as in pl.34, fig.1, of hirtipes. Venation as in hirtipes, the vein R_{2+3} being present; but M_{1+2} bends down into cell M_{1+2} slightly more than in the wing just mentioned. Length 3.5 to 4mm. Length of one wing 5mm. Ac-

cording to Mr Coquillett the species also occurs in Colorado and Montana [pl.38, fig.21].

Moscow Id. (June 19).

S. glaucum Coquillett

U. S. Nat. Mus. Proc. 1902. 25:97

Male. Head and body black, face gray pruinose, thorax bluish gray pruinose, mesonotum marked with a narrow median and slightly wider lateral black vittae, broad lateral margins, when viewed from behind silvery white, a pair of large subquadrate spots on the front end separated by the median black vitta, which is here greatly dilated; abdomen velvet black, sides of segments two and five to nine silvery, middle of dorsum of four also silvery; venter almost wholly silvery; femora and tibiae brown, bases of tibiae yellow, anterior side of front ones largely silvery; tarsi black, broad base of first joint of the middle and hind ones whitish; wings hyaline, veins along the costa yellowish brown, the others nearly hyaline; halteres yellow; length, 2.5mm.

In April. Kansas City, Missouri.

S. griseum Coquillett

Dep't Agric. Div. Ent. Bul. 10, n. s. 1898. p.69. Colorado

Female. Front and middle femora and tibiae wholly yellow, hind ones except their apexes also yellow, tarsi brown, bases of the first two joints of the middle and hind ones yellow; mesonotum grayish, indications of a darker median vitta, the sides and front corners yellow, pleura light gray, scutellum yellow; abdomen gray, segments 2 to 6 each marked with three velvet-black spots; wings hyaline, the costa, first three veins, and first section of the fourth, yellow, the others subhyaline; face and front light gray, antennae brown, the two basal joints yellow, palpi black, proboscis yellowish. Length 1.5mm. Colorado. Three females, collected by Mr Carl F. Baker.

Male. Center of mesonotum with a narrow black vitta, mesonotum elsewhere gray, dorsum of abdomen velvet-black, the second and seventh segments and a spot on the sides of the eighth, silvery gray, otherwise as in the female. A male taken with the female specimens.

S. hirtipes Fries

Obs. entomol. Pars 1. Monogr. Simuliar. 1824. 17:5, Tfl. 1, f.1.
1830 rufipes Meigen, Syst. Beschr. 6:311-17
1830 hirtipes Fries, Meigen, Syst. Beschr. 6:312-18
1850 hirtipes Fries, Zetterstedt, Dipt. Scand. 9:3426-28

Male. Black. Eyes contiguous, upper facets larger than the lower; antennae brownish black, including the two rather elongate basal joints, sparsely covered with short grayish white pile; palpi black, hairy, four jointed, the second joint rather wide and flattened. Thorax black, unstriped, the dorsum sparsely covered with an appressed, golden yellow pile, mixed with some black hairs; the scutellum black, with a tuft of long, nearly erect yellow hairs on each side; metanotum black, nearly bare; pleurae brownish black, bare and subshining.

Abdomen black, the basal half of each segment velvet-black, the apical half of each segment (sometimes only the margin) subshining, brownish black, everywhere thinly covered with an appressed pile of yellowish brown and black hairs, the yellow hairs visible only in certain lights, so that both thorax and abdomen appear black. On each side on the leaflike posterior margin of the first abdominal segment is a fringe of long, dark brown hairs. Legs brown to brownish black, including the coxae; the tarsi are usually slightly darker; anterior tibiae with one spur, middle and hind tibiae each with a pair; the legs, particularly the posterior ones, densely covered with pale brown or yellowish hairs, posterior metatarsi as long as the following four joints taken together, wider than the tibia, flattened laterally; all tarsal claws tridentate. Halteres entirely black. Wings brownish yellow tinged, and usually both branches of media, and the first and second anal veins brown clouded. This is most apparent in a balsam-mounted wing. The radius is three branched [see figure]. Length of dried specimens 3.5 to 4.5mm.

Female. Black, everywhere thickly covered with golden yellow, appressed pile, so that the fly appears somewhat yellowish. Eyes separated, the front black with appressed yellow pile; antennae brownish black, the first two joints paler, sparsely covered with short, appressed pale yellow pile, and a few scattered black hairs; palpi dark brown, the mouth parts reddish brown with black tips. Dorsum of thorax black, unstriped, thickly covered with golden yellow, appressed pile; scutellum black, with a tuft of long, nearly erect yellow hairs at the sides, metanotum subshining, brownish black, bare; pleurae brownish black, bare, and subshining. Abdomen black, when viewed from behind the posterior margins of the segments often appear yellowish white; wholly covered with yellow appressed pile. On the sides of the leaflike, posterior margin of the first abdominal segment is a fringe of long yellow hairs. The coxae are black; legs yellow, the knees, the tips of the tibiae and all the tarsal joints slightly darker, the anterior tarsi specially, sometimes brown; hind metatarsi elongate and flattened, though not so

wide as in the male. Anterior tibiae each with one spur, middle and hind tibiae each with a pair. The tarsal claws are simple; wings as in the male, though the media and anal veins are unaccompanied by the brownish cloud. Halteres fuscous, peduncle slightly paler. Length of dried specimens 3.5 to 4.5mm; wing, 3.5 to 4.5mm.

Described from many bred and captured specimens, from Coy glen, Ithaca N. Y., May 1901, and Adirondack mountains, June 1901, Moscow, Spaulding and Peck, Id.; from Professor Aldrich.

I have compared this with European specimens, and find that they agree in every particular excepting that the foreign specimens I have are a little smaller. A number of female specimens collected by Messrs McGillivray and Houghton on Mt Seward in the Adirondacks, agree perfectly even in size with those from Europe. According to the testimony of the gentlemen named, these flies are most persistent biters. Those found around Ithaca are known to annoy horses, and also have been caught biting human beings.

Larvae. In this State they are found in the latter part of April and the first two weeks of May; most of them pupating before the middle of May; the adults appearing eight or nine days after pupation. Some adults appear as early as May 1. The head of the larva is quadrangular, of a rich brown color, the posterior margin nearly black, with a black, divided eye spot on each side. The antennae are slender, first joint occupies about two thirds the whole length, the third joint being pointed, and but little longer than wide [pl. 34, fig. 5]. The fans have 30 to 50 scythe-shaped rays, each with a row of fine cilia on the inner side, at regular intervals with a longer and stouter seta [pl. 34, fig. 8]. The mandibles are stout, with the usual teeth, the apical ones being black, the others paler. The large one most remote from the apex is not so differentiated as with other species. The pair of apical bristles is partly hidden by the hair at apex. The maxillae are wider than long; the palpus being only about twice as long as broad. At the base of the palpus is a tuft of fine setae, and covering it are a few slender bristles [pl.34, fig.3]. The labium has seven apical teeth, all but the outer ones being trifid; on its ventral surface are two rows of five bristles each [pl.34, fig.4]. The labium and hypopharynx as in the other species. The dorsal surface of the thoracic segments is of a dirty yellow color, the ventral surface is nearly

white. On each side is a triangular shaped spot which marks the position of the future respiratory filaments of the pupa. The basal half of the thoracic proleg is fuscous, its apex paler. Extending from the base of the proleg to the first abdominal segment is a broad, dark line with sinous margins. The abdomen is fuscous, paler at the sutures and on the ventral surface. The underside of the last two or three segments is nearly white. The hooks (about 100 rows, 12 in a row) forming the margin of the sucker are dark brown [pl.34, fig.11–12]. In some specimens a fine fuscous line extends the whole length of the ventral surface on the median line. Just before pupation the developing ventral hooks of the pupa become visible. Though retracted in nearly all the material studied, I have found that the blood gills of the last abdominal segment consist of three unbranched lobes.

Pupa [pl.34, fig.10]. Rich brown in color; the two tufts of thoracic respiratory filaments (one tuft on each side) are each divided primarily near the base into four main branches, the two inner ones larger than the outer ones, each branch again dividing two or three times into twigs, so that upward of 60 filaments may be counted. On the ventral surface close to the posterior margin of the last six abdominal segments are four larger upward curved spines; on the dorsal surface near the base of each abdominal segment is a close row of spines projecting caudad, and on the dorsal and lateral surface of these segments, a short distance from the margin, is a row of fine spines projecting cephalad. The last named are not quite so close to the margin, nor are they nearly as large. In the figure the segments are contracted, and the caudad projecting spines appear to be attached to the posterior margin, whereas they belong to the middle of the dorsal surface of the following segment. At the apex of the last segment are two stout hooks projecting dorsad and cephalad. The pupal cases consist of a dark matted mass of silk, of no definite form, secreted on the rock, and in which the pupae are partially imbedded. The pupal life lasts about eight or nine days.

From Professor Kellogg (Leland Stanford Jr University, Cal.) I received specimens of larvae and pupae which agree very closely with those just described. These specimens (collected on the university campus) appear to differ only in that the labium of the larvae possesses but three bristles in each row on the ventral surface. Specimens from Professor Aldrich (Idaho) are identical with those from New York State.

S. invenustum Walker

List of Diptera. Brit. Mus. 1848

Nigrum, cinereo subfuscum, abdomine basi fulvo hirto, antennis piceis, pedibus fulvis, alis limpidis. Fem.; *Cinereum, antennis nigris, pedibus rufo-cinereis, tarsis nigris.*

Body black, overspread with a grayish bloom; base of the abdomen clothed with tawny hairs; feelers piceous; legs tawny and clothed with tawny hairs; wings colorless; fore border veins brown; the other veins tawny and slender; poisers piceous. Female. Body gray; feelers black; legs reddish gray; feet black.

Length of the body 3mm; of the wings 7mm.

St Martin's falls, Albany river, Hudson bay. Presented by Mr G. Barnston. This is said by Mr D. W. Coquillett to be the species which C. V. Riley called p e c u a r u m.

S. irritatum Lugger

Minn. Agric. Exp. Sta. Bul. 48. 1896. p.204

Figures are given of both male and female in the bulletin, but without description. Neither is its life history given, though it was apparently known to Mr Lugger. Both the male and female are represented with an unstriped thorax, a fasciate abdomen, and bicolored legs. The male appears to have a light spot on the anterior margin of each segment of the abdomen and a pair of spots on the anterior margin of the thorax. This species is said to be the most common black fly in the central part of Minnesota.

It is to be hoped that this species may again be found and fully described in the near future.

S. metallicum Bellardi

Saggio, etc. 1859. 1:14

Male. Metallic blue black. The base of the antennae, the halteres, the fore femora, the middle portions of the fore tibiae, the bases of the middle and hind tibiae, the bases of the first and second joints of the middle and hind tarsi, are white. Wings hyaline; its veins rather indistinct. Length of body 2mm; extended wings 5mm. Mexico.

S. meridionale Riley

Dep't Agric. An. Rep't for 1886. 1887. p.512 (turkey gnat) 1891; S. o c c i d e n t a l e Townsend, Psyche, July 1891, p.107 (synonymy according to Coquillett).

Female. Length 2.5mm to 3mm. Head uniform slate-blue, verging to greenish, or cerulean blue in some lights, clothed with silvery pubescence, which becomes longer behind the eyes; parts below the antennae and trophi more densely pubescent, producing the effect of a white face; eyes with a metallic coppery luster; antennae black with very dense white pubescence; no bristles on basal two joints, which are but very slightly tinged with red; joint 1 shortest; joints 2, 3, and 11, subequal in length; joint 3 widest; joints 4 to 9 subequal in length; joint 10 but slightly shorter than joint 11, which is fusiform; joints 3 to 11 gradually decreasing in width. Maxillary palpi as long as antennae, blackish, with long, whitish bristles. Thorax slate-blue, with less dense, silvery white pubescence; markings quite distinct, producing the effect of a sculpture, and consisting of three black longitudinal lines, the median narrow, widening a little at the apex, and the outer one curving inward at base, and outward at apex, sometimes reaching to base of patagium, which appears whitish on account of the dense pubescence; on the lateral edges of prothorax are fine black sutures; underside uniform slate-blue, with sparse pubescence; space around the large stigma almost white. Halteres white, very faintly tinged with red. Abdomen nine jointed, joints subequal in length, except the last two, which decrease; markings entirely different from those of S. p e c u a r u m, formed by velvety black, dark blue and bluish white, almost silvery, colors; the dark blue appears on dorsal surface of the last five segments, spreading from a roundish median spot, on 5 to the immaculate blue of the last two segments; segments 2, 3, and 4 have each a black cross-bar, and 5, 6, and 7, two narrow, black submedian stripes, which disappear almost entirely on 7; the bluish white forms an outer edge to all the black and extends over the whole lower surface of the abdomen, with the exception of more or less well marked black cross lines in middle of each segment; a bluish white or silvery pubescence covers the entire abdomen, but is very sparse on the dorsal parts. Legs brownish black; tarsi almost black, and more or less densely covered with white hairs. Wings, subhyaline. Veins bluish white, base ferruginous. Described from many bred and captured specimens.

Male. Length 1.5mm to 2mm. Very different in appearance from female. Eyes confluent, very large, brilliant coppery; a very marked difference in the size of the facets, those on upper surface being very large and metallic copper, those below and surrounding trophi becoming suddenly small, black, with bronze reflections; trophi reddish black, dwarfed; antennae black, with light, yellowish brown pubescence in front. Thorax above in-

tense black, velvety with a bluish luster; underside grayish. Legs reddish with black tarsi. Wing hyaline, veins and base bluish white. Abdomen; above, black with posterior margins of segments edged with gray; undersides of segments 2 and 3 light, reddish gray, the others blackish, with gray posterior margins. Sexual organs black. Thorax and abdomen very sparsely clothed with white pubescence. Described from three bred specimens.

Larva. Length when full grown 5.5mm to 7mm. Normal shape and general appearance differ from S. p e c u a r u m by the much more irregular markings of segments and head. A majority of the larvae possess one or two lateral spots on club-shaped posterior third of body. Head lacks the regular arrangement of spots and lines, which become confused; the two black spots on each side present. Antennae uniformly pale, much longer than in p e c u a r u m, slender and three jointed; first joint almost twice as long as joints 2 and 3 together, and a little bent; at base three times and at tip twice as thick as second joint, which is nearly uniform in width, tapering but very slightly toward the tip; joint 3 small and pointed, about one fifth as long as joint 2. Mentum similar to that of S. p e c u a r u m, but distinguished by a flatter apex, by the possession of three erect bristles on each side, starting from round pores, which decrease in size toward base; a fourth very small bristle close to base, and in line with the bristles above; the sides of mentum have on each side four sharp teeth. Labrum and labium not different from those of p e c u a r u m. Mandibles possess but seven teeth in the first row; the three first nearly uniform in length; teeth 4 to 7 gradually decrease in length; tooth 4 much the longest of all; the two teeth in the second row similar to those of p e c u a r u m. Maxillae and maxillary palpus also similar. Fans similar, but the hairs lining the inside of the scythe-shaped rays are thicker and nearer together. Prolegs, more slender, last joint bearing a crown of hooks, usually bent suddenly toward head. Tip of abdomen similar to that of p e c u a r u m. Breathing organs quite different; the three main trunks branch each six times, and the branches enter the trunk from both sides. Full grown larvae show also the newly formed, coiled breathing tubes of the pupae through their skin. Described from many specimens.

Pupa. Average length 3.5mm; shape and colorations as in S. p e c u a r u m. The thoracic filaments consist only of the six original rays, which do not branch. On dorsal surface of the posterior margins of abdominal joints 4 and 5 is a row of eight anteriorly curved hooks, similar to those of p e c u a r u m, but

none on joint 3; anterior margin of joint 9, and of subjoint with a continuous row of smaller, anteriorly curved hooks; joints 7 and 8 unarmed dorsally; ventrally joints 6, 7 and 8 have each four minor hooks.

Cocoon. Length 3.5mm. Neater than that of any other species known to me, being formed of fine threads, lined with gelatinous ones. The web is quite dense, uniform, with well defined, sometimes thickened ribs. The cocoon is always securely fastened singly to leaf or stick, and if many are fastened on the same leaf, they do not crowd each other. It fits snugly about the pupa, which is so securely anchored inside as to be with difficulty extricated.

Several female specimens taken by Messrs MacGillivray and Houghton at Axton N. Y. in company with S. v i t t a t u m agree perfectly with Coquillett's description, though not so well with Riley's. Coquillett's description of the female in United States Dep't Agric. bulletin 10, new series, reads as follows:

Abdomen of female gray, marked with a velvet-black fascia on segments 3 and 4, and sometimes with two subdorsal spots of the same color on 2, 5 and 6; thorax bluish gray with three black vittae.

The blue color on the abdomen spoken of by Riley in his description is not distinguishable in the dried cotype specimen, the posterior segments appearing grayish. In the male the thorax is velvety black, with a few pale yellow hairs, specially anteriorly and posteriorly. The abdomen is velvet-black, the posterior margins of segments sometimes pale. The fore tibia possesses a single spur, the middle and hind ones each with a pair [pl.38, fig.12]. All tarsal claws of the male trifid [pl.38, fig.18]; of the female bifid [pl.38, fig.16].

It may be mentioned that what Riley calls mentum I have termed labium. To Riley's description of the larvae may be added that the apical pair of bristles of the mandible is not present or at least is not differentiated from the other hairs; the labrum and hypopharynx [pl. 33, fig.11, 3] resemble those of other species; the labium has four pairs of setae [pl.33, fig.4], one of which is quite small; the maxillary palpus has no setae on the last joint, and but few hairs on the basal joint. No spines are apparent at tip of the last abdominal joint of pupae,

the other spines and hooks are as described by Riley. This species has been reported from New York. I have also seen specimens from Moscow and Albion Id., Lawrence Kan. and Axton N. Y.; those from Idaho and Kansas belonging to Professor Aldrich.

S. mexicanum Bellardi

Saggio etc. Apx. 6. 1862

Male. Black. Head black, front prominent, triangular, with whitish reflection; antennae black, first joint and base of second yellow; face prominent, black, the epistome yellowish, with grayish reflection; palpi black, paler at the base; thorax wide, subquadrate, slightly convex, black, with a grayish reflection, with yellow pile? (aureo-squamuloso); humeri pale; pleurae black, anteriorly and posteriorly with fuscous spots; scutellum fuscous; the halteres white; abdomen black, the base of the second segment pale yellowish, the second, third, fourth and fifth pale yellowish on the sides; fore and middle coxae wholly yellow, hind ones fuscous with yellow tips; fore femora wholly yellow, the middle and hind pairs fuscous black, at base and tip yellow; all tibiae fuscous-black with yellow bases; fore tarsi wholly black; middle tarsi black, with bases of all the joints yellow; hind tarsi black with base of first joint widely and second joint narrowly yellow; wings hyaline iridescent. Length 4mm; extended wings 9mm.

Mexico.

S. minutum Lugger

(= S. vittatum Zett.)

Minn. Agric. Exp. Sta. Bul. 48. 1896. p.202.

The bulletin mentioned above contains a figure of the female of a species which is said to be common near Minneapolis from May 15 to June 1. No description is given excepting the statement that it is very small. The figure represents a fly with an unstriped thorax, the abdomen with a dark fascia on each segment, the fascia covering nearly the entire dorsal surface of each segment, excepting the narrow basal and lateral margins. Its legs are bicolored. Specimens bearing the label S. minutum received for study from Mr Washburn proved to be S. vittatum Zett.

S. occidentale Townsend

Psyche. 1891

Female. Cinereous; abdomen light fulvous. Head cinereous, eyes black; face cinereous, raised and somewhat darker in the center, sparsely clothed with fine silvery hairs; front cinereous,

widened below into a crossbar, a prong invading the orbital area on each side; silvery pubescent on occipital margin; proboscis black, brownish at the tip, palpi black; antennae cinereous, with short silvery pubescence, the two basal joints longer than the following joints, which are nearly equal in length; occiput cinereous with silvery pubescence around the margin.

Thorax cinereous, mesoscutum entirely covered with silvery pubescence, with two dorsal lines and usually a fainter median line between them; pleurae fulvous posteriorly, scutellum black, silvery pubescent. Abdomen light fulvous sparsely covered with short silver pubescence. Second, third and fourth segments above with a brown cross band shading to darker on the sides and in the middle, particularly on the third and fourth segments, remaining segments with a broad, median, dorsal, cinereous band, bounded laterally on fifth, sixth and seventh segments by a curved more or less faint line of brown; venter light fulvous, silvery pubescent. Legs black, silvery pubescent. Wings hyaline, iridescent by reflected lights; halteres white. Length of body 2mm; of the wings 2mm.

Described from many fresh specimens. This species is smaller than either S. pecuarum, or S. meridionale. S. metallicum Bell. from Mexico is given as 2mm long, but the male is described. The female would be much larger.

I have examined specimens from New Mexico, kindly sent me by Professor Aldrich of Idaho, to whom the specimens were sent by Mr Townsend, and named occidentale. The only difference I have been able to discover between this and meridionale is its smaller average size. The tarsal claws are as in meridionale. The abdominal markings were too indistinct, owing to shrinkage, to allow of comparison. For the present I regard it as a small variety of meridionale.

S. ochraceum Walker

Ent. Soc. Lond. Trans. 5:332

Female. Testaceous, with white tomentum; head white; antennae testaceous; thorax ochraceous, with two white stripes; abdomen blackish, testaceous at the base; femora and tibiae with black tips; tarsi black, testaceous toward the base; wings vitreous; veins pale testaceous. Length of body 2mm; of wings 4½mm. Mexico.

This species can hardly be the female of S. metallicum Bellardi.

S. pecuarum Riley

U. S. Dep't Agric. Rep't for 1886. 1887. p.512 (Coquillett considers this a synonym of S. invenustum Walker)

Plate 33, fig.6–11

Female. Length 2.5mm to 4mm. Head uniform grayish slate, clothed with short yellowish hair, which becomes longer behind the eyes; eyes black, with coppery or brassy reflections; antennae black, with whitish pubescence, and with a few bristles on two basal joints, which are tinged with red, joints 1 to 11 gradually diminishing in thickness toward the last, joint 1 the shortest, joints 2 and 3 twice as long as joint 1, joints 4, 5 and 6 as long as joint 1, joints 7, 8, 9 and 10 gradually increasing in length, last joint fusiform, twice as long as joint 10. Maxillary palpi a little longer than the antennae, blackish, with long grayish bristles.

Thorax grayish slate, more or less densely covered with short, yellow hairs, and with usually very distinct markings, consisting of two median dorsal, and two subdorsal broad, longitudinal, sooty black bands, of which the latter curve to posterior edge of patagium, which is reddish at tip; lateral edges of prothorax with fine black sutures; underside of the thorax uniform grayish slate, with sparse yellow hairs, space around the one large stigma lighter; halteres opaque, reddish white; legs uniform reddish brown, densely covered with yellowish hairs; tips of the tarsi blackish; wings subhyaline; larger veins and base reddish brown.

Abdomen nine jointed; joints subequal in length except the last two, which decrease in length; a longitudinal, broad, bluish gray dorsal band extends from near the base of second segment, where it is broadest, to the tip curving downward to the anterior lateral edge of seventh segment; below this band laterally the color is blackish brown, with the exception of a broad bluish gray transverse band on the posterior edge of each of the segments from 1 to 6; underside of abdomen uniform brownish gray, without markings; abdomen densely covered with yellowish hair, which is very long upon the posterior edge of segment 1, forming an overlapping fringe.

Male. Length 1.5 to 2.2mm; differs considerably from the female. Head not visible from above, being occupied by the very large confluent eyes; the remaining parts below the eyes are black, with black hairs and bristles; eyes composed of two different kinds of facets, those above very large, twice as large as those of female, and those in front and surrounding the dwarfed trophi very minute, the dividing line between the sizes being abrupt; antenna similar to the female, more pro-

nounced in color, both the black and reddish being more vivid; maxillary palpi black, and shorter than the antennae. Thorax black above with sparse yellow hairs; legs somewhat lighter in color, tip of the tarsi not black; hairs upon the legs longer than those of the female. Wings hyaline, veins and base yellowish brown. Abdomen black with grayish white posterior margins to the segments dorsally and laterally, and covered with longer yellowish hair. Described from two bred specimens.

Larva. Average length when full grown 7mm to 8mm, subcylindric, the club-shaped posterior third of body being twice as stout as the thoracic joints, and joint 4 the most constricted. Translucent when living, dirty white in alcohol. Immaculate in a very few specimens; distinctly marked in the great majority with brownish dorsal cross bands in middle of joints, leaving free a white mediodorsal longitudinal line. Thoracic joints with three irregular rings of the same color; underside more or less irregularly spotted with brown. Head subquadrate, horny, yellowish brown, with a number of brown spots and lines in regular order, and two roundish, approximate ocellate, black dots on each side under the skin, and seemingly rudimentary organs of sight, from which the future eyes originate. Antennae uniformly pale, three jointed, about one third as long as greatest width of the head; joint 1 very stout, fully four times as thick as 2, which is a little longer than 1, straight, slightly tapering toward the tip. Joint 3 extremely small, a mere triangular tip; mentum subtriangular, with apex cut away, and replaced by three groups of very small teeth, of which the central group consists of three teeth, the middle one largest; and the groups on sides, of four teeth, of which the second from center is largest. Sides of mentum, near the apex, with two small teeth each; all the teeth are chitinous and black; a long erect bristle, pointing upward and inward, near each side of mentum; labrum horny, densely covered with hair; mandibles resembling in shape the profile of the inverted last joint of the human thumb, with a series of teeth in place of the nail. Teeth difficult to see, owing to the presence of five distinct brushes of hair; on extreme lower tip of mandibles three large teeth; below them a series of 11 slender and very pointed teeth, of which the first two are the smallest, teeth 3 to 9 increasing and teeth 10 and 11 decreasing gradually in length; a second series of teeth below them consists of two triangular teeth, of which the first is largest. Maxilla stout, fleshy, with an internal thumb-shaped lobe; maxillary palpus two jointed, first joint cylindric; second very short, crowned with a regular circular row of short spines or warts; labium

horny with two brushes of hair above, between which is a very small ligula, covered with a small brush of hairs. Fans, composed of stout stem, bearing about 46 scythe-shaped rays, lined on the inside by very minute, equidistant, erect hairs of equal length. Thoracic proleg, faintly four jointed, subconical, retractile (introversible), very thin and transparent, crowned with about 20 rows of short, sharp hooks, apparently arranged in a circular manner; the hooks, of which 10 are in each row, seem to be movable to a certain extent, and are fastened or hinged to small chitinous rods in the epidermis. Tip of abdomen formed by a subcylindric body crowned with rows of hooks. Breathing organs below these hooks and on the upper side of abdomen; they consist of three short, cylindric, soft and retractile tentacles, which connect with large internal tracheae. In full grown larvae a spot more or less dark is seen on each side of thoracic joint; it is produced by the formation of the coiled breathing tubes of the future pupa.

Pupa. General color when fresh, honey-yellow; prothoracic filaments brown, and the abdomen dorsally also tinged with brown, except a mediodorsal space. All the members have also a fine brown marginal line; prothoracic filaments consisting of six main rays, issuing from the basal prominence and subdivided two or three times, so that in most cases as many as 48 terminal filaments can be counted. Abdominal joints three, four, and five, each with eight well separated, dark brown and anteriorly recurved hooks. The four on each side separated by a mediodorsal space; those on joint 3 less conspicuous than those on joints 4 and 5; joint 6 without armature; joints 7, 8 and 9, and also subjoint less distinctly armed near anterior margin with a continuous dorsal row of very minute posteriorly recurved points; ventrally joints 6, 7, and 8 have each four very minute anteriorly recurved hooks.

Cocoon. Average length 3.5mm. Not completely made and not entirely covering the pupa, but tightly surrounding its larger portion. Shape very irregular, with no distinct rim at the upper edge, which is more or less ragged. The threads composing it are very coarse, and the meshes rather open and ordinarily filled with mud. Not always fastened separately to objects, but frequently crowded together without forming, however, such corallike aggregations as in some of the northern species.

That part which Riley called the labium in the above description, appears to be a combination of labium proper and the hypopharynx. Often in dissection these two parts stick together and appear as one, but with a little care the hypo-

pharynx can always be removed entire. To the above description I may add that the apical pair of bristles of the mandibles [fig. 6] are present, though slender, the labrum and hypopharynx [fig. 7] as in other species; the labium [fig. 8] has the middle tooth trifid, and there are three setae (instead of one, as Riley has it) in each row on the ventral side. The maxillary palpi have a few slender setae and there are also a few on the basal joint [fig. 9].

I find eight abdominal segments plus the anal segment in the pupa [fig. 10], and not nine, as Riley has it. Therefore the eight hooks are on each of segments 2, 3 and 4, and not 3, 4 and 5. Dorsally, on each of segments 5, 6 and 9 is a transverse row of minute caudad projecting spines; 7 and 8 with slightly larger ones. Ventrally, segments 5, 6 and 7 each with four large spines curved cephalad. In the Cornell University collection are four specimens of adults, two males and two females, obtained from Riley.

S. pictipes Hagen

Bost. Soc. Nat. Hist. Proc. 1880. 20:305

1895 S. innoxium Comstock, Manual for the Study of Insects

Male. Eyes very broadly contiguous, the large facets distinctly separated from the small by a horizontal line. Face small, as broad opposite the insertion of the antennae as its length, considerably narrowed below; a deep groove on either side running obliquely to the inferior angle, the median part arched; in color grayish pruinose, or in some reflections almost silvery; antennae situated at about the lower fourth in profile; in color black with a slight pruinosity; palpi black, slender, the first three joints somewhat thickened. Metanotum thinly covered with golden pubescence; in color velvet-black, the lateral margins and a spot running upward and inward from each humerus gray and yellowish gray, but somewhat variable in different reflections. Mesad of these gray humeral spots is a pair of small silvery spots. Pleurae, pectus and coxae, gray pruinose, showing in some reflections the black ground color. Abdomen with eight visible segments, in color deep velvet-black; under the leaflike margins of the first segments and the sides of the remaining segments gray, or in some reflections silvery pruinose. Legs black or dark brown, the basal part of the dilated hind metatarsal joint yellow, in some specimens the ex-

treme base of the tibiae yellowish, with a single short spur on the fore tibiae, and a pair of longer ones on middle and hind tibiae [pl.38, fig.8]. Fore and middle tarsi slender, hind ones widened, all claws trifid [pl.38, fig.8, 17]. Wings hyaline or slightly tinged; the anterior veins thickened, the remainder slender [pl.36, fig.7]. Knob of halteres orange yellow. The male genital organs are short though rather complex, consisting of a pair of outer sheaths, then a pair of elongate blunt processes, within which are two pairs of hooks; the outer, shorter pair are incurved and clawlike; the longer, inner pair are slender, with some outwardly projecting hooks. Length 3.5 to 4mm.

Female. Eyes with a small deep sinus on each side, just about the base of the antennae, above which the front is a little longer than wide, and a little wider above than below. Face a little wider than the narrow part of the front, the sides parallel, its surface gently and evenly convex, clothed with white hairs; antennae tapering more than in the males, the first two joints yellowish. Basal joints of palpi stouter. Facets of eyes uniformly small, the eyes much smaller and the posterior orbits conspicuous. Thorax like the head, opaque gray pruinose. Metanotum with three slender, deep brown or black stripes, the lateral ones gently incurved back of the anterior knoblike dilation. Abdomen velvet-black, the second segment (or the part beneath the leaflike margins of the first) and the posterior margins of three following segments (except at the center), opaque gray or grayish white; the remaining segments, and leaflike sides of the first, lightly pruinose; venter gray; in some specimens with a small black or grayish triangular spot on center of the dorsum of segments 3, 4 and 5. The legs grayish, in some specimens quite pale; the tips of some or all the tibiae usually, and the tarsi nearly always, black, except the bases of hind metatarsi and sometimes the middle also, which are yellow. The tibial spurs and hind metatarsi as with the male. Tarsal claws simple [pl.38, fig.20]. Wings as with the male. Knob of halteres yellowish white. Length 3 to 4mm.

I have compared this species with Hagen's type, (larvae, pupae and adults) and find that they agree perfectly. The apparent discrepancy in comparing Hagen's description[1] with the one given above is due to the fact that Hagen described his from bottled material. His description agrees very well with alcoholic material of this very common Ithaca species. Hagen was in error in regard to the number of respiratory filaments of

[1]Bost. Soc. Nat. Hist. Proc. 20:305.

the pupa, in stating that there were but eight; for, on examination of the Cambridge material, nine filaments were counted. Coquillett (1898) says of the male mesonotum, "usually with three black vittae"; but this I have found to be an exception rather than a rule.

Recorded from New York, Texas, California, and Moscow Id. (Collected by Aldrich).

Larva. Length 10 to 12mm. Plate 36.

The fans of this species have about 60 rays; the cilia and the regularly arranged setae on the inside of the rays are very distinct. The antennae, light brown in color, are three jointed, the second joint about one third as long as the first, the third very short and pointed, the extremities of the first and second are hyaline, the two small budlike processes at the end of the first and the second joint are brown. The mandibles possess the apical pair of bristles, the apical teeth are quite black, the others paler; the maxillary palpus with a few scattered bristles on the shaft and at the base. Labrum and hypopharynx as usual, in the latter the lateral hornlike processes are quite prominent. Labium with the toothed area rather narrow, the lateral and middle teeth elongate, the ventral surface with two rows of 10 or 11 bristles each [fig.3]. The thorax and abdomen are a deep black; paler at the incisures, and on the ventral surface, particularly toward the caudal end. A narrow black longitudinal, ventral stripe is often present. The blood gills consist of three many branched papillae.

Pupa. The two thoracic respiratory organs each consist of nine filaments; eight of which are about equal in length, the ninth arises a little lower on the shaft, and is somewhat shorter [fig.8]. On the dorsal surface of each of the segments 2, 3, 4, and 8, are eight black hooks curved cephalad, those on the second and the eighth segments being much smaller than the others. Ventrally 5, 6 and 7 each, with four double, curved hooks, on the caudal segments are two very short blunt spines, and three smaller ones on each side of 3, 4 and 5. The pupal case is of the boot-shaped type [pl.35, fig.5].

S. pulchrum Philippi

Chilian Diptera. 1865. p.633

1896 S. tarsale Williston, Dipt. of St Vincent, p.268

Female. Abdomen black, the proximal segments opaque, the distal four segments shining. Length 2mm.

Front and face black, with a light gray reflection. Antennae yellow; the distal joints somewhat brownish. Mesonotum deep

black; in front, opaque with a silvery shimmer, and with sparse, short, curly, golden yellow tomentum; behind, shining. Pleura black, whitish pruinose. Abdomen black, the basal segments opaque, the distal four segments somewhat shining, and with a delicate whitish pruinosity. Legs reddish yellow; tarsi black, except that the proximal half of the middle and hind metatarsi is light yellow; first and third joints of the front pair each with two long hairs; second and third joints of the same pair dilated, the fourth and fifth very small; hind metatarsi elongate and stout, the following two joints a little dilated, the fourth and fifth small. Wings hyaline; veins yellow. *Williston*

Three specimens. The above synonymy is according to Hunter.

This species seems to resemble greatly S. venustum excepting for the color of its legs.

S. quadrivittatum Loew

Berl. Ent. Zeitschr. 1862. Centur. 2, p.186

Black opaque, the thorax with four white vittae; the halteres yellow; middle and hind tibiae and tarsi white banded; wings hyaline. Body 1.67mm; wing 1.67mm.

Black, opaque. Antennae fuscous; dorsum of the thorax with four longitudinal lines, the posterior margin whitish pollinose; scutellum spotless; the pleural spots and the metanotum whitish pollinose; the legs fuscous black; the knees and the bases of the metatarsi of the fore legs, the basal rings of the middle and hind tibiae, the metatarsi excepting the tip, and the bases of the second and third tarsal joints are white; halteres yellow; wings hyaline, the heavier veins deep yellow. Cuba.

S. reptans Linnaeus

Fauna Suec. 1803. 1761 (Synonymy according to Schiner, 2)

1767 sericea Linnaeus, Syst. Nat. 12:978, no. 58
1776 erythrocephala DeGeer, Ins. 6:161, no. 37 (Tipula)
1781 reptans L. Schrank, Enum. Ins. Austr. p.985 (Culex)
1804 argyropeza Meigen, Syst. Beschr. 1:291-92
1818 reptans Meigen, Syst. Beschr. 1:291-92
1818 sericea Meigen, Syst. Beschr. 1:296-98
1818 elegans Meigen, Syst. Beschr. 1:296-99
1818 variegata Meigen, Syst. Beschr. 1:292-93
1823 reptans Fries, Obs. Entomol. Pars 1 Monogr. Simul. 1:13
1830 cincta Meigen, Syst. Beschr. 6:311-14
1838 posticata Meigen, Syst. Beschr. 7:52, 21

Male. Velvet-black; dorsum of the thorax with a silvery white margin, spotlike on the humerus, broadly interrupted in front;

visible only in certain lights. Pleura also with a whitish reflection; abdomen with silvery white spots on the second and on the last two segments, wanting in rubbed specimens; the posterior margin of the first segment with long and dense brownish cilia. Head black, face grayish white; antennae and palpi brownish black, the former more slender than is usual with the members of this genus, with whitish reflections on some parts. Legs dark brown; front coxae yellowish, fore tibiae silvery white outwardly; middle tibiae yellow at the base, hind tibiae likewise, though in less degree, light brown, with a whitish reflection; metatarsi of the hind legs yellowish at the base; the hairs of the fore and hind femora, and particularly on the extensor surface of the hind tibiae, conspicuous. Halteres bright yellow; wings purely hyaline, with delicate and transparent veins, those of the anterior margin being somewhat thicker and more conspicuous; the wing surface with a golden brown reflection; the media not petiolate. The short, scattered hair of the thorax seldom distinct, the color of the legs variable in intensity.

Female. In coloring does not resemble the male in the least. The ground color is blackish brown; the dorsum of the thorax covered with a depressed yellow pile, on the margins with a whitish reflection, on the center with a grayish reflection, the pleurae grayish white. Abdomen somewhat shining; on the sides whitish or yellowish gray; on the venter, at least at the base, in living specimens, yellow, which is continued around on the dorsum in some specimens, usually not distinct in dried specimens. Legs brown, usually paler than those of the male; the tibiae, with the exception of the tip, and the fore coxae whitish or yellowish white, the tips of the tibiae and the tarsi black, the basal half of the hind metatarsi and sometimes also the extreme base of the following joint yellowish. Front and face gray; antennae and palpi brown, the former paler at the base. In other particulars as with the male. Length 2 to 3mm. Translation from Schiner, *Fauna Austriaca*, 2:365

According to Schiner [*loc. cit.*] this is the species whose life history has been described by Fries, Westwood and Heeger. According to Schiner also, s e r i c e a is a synonym of r e p t a n s. Of s e r i c e a Westwood writes that the larva possesses three unbranched blood gills, and that the pupa has eight thoracic respiratory filaments on each side.

This European species has been reported by Lundbeck as occurring in Greenland. (Diptera groenlandica, 1898)

S. tamaulipense Townsend

N. Y. Ent. Soc. Jour. 1897. 5:171–72

Female. Length 1.5mm. Near S. meridionale, but smaller, and the outer one on each side of the three thoracic lines not curved outward at posterior end. Eyes velvet-black, face and front silvery; front with usually a trace of a linear black vitta, in one specimen very distinct, in another entirely wanting. Antennae yellowish with a silvery covering. Thorax silvery, with three longitudinal lines; middle one longest, very narrow and linear; outer ones heavier, straight, slightly divergent posteriorly. Looked at directly from above, the outer lines appear curved, outwardly convex. Scutellum and metascutum below scutellum, both brownish in some lights but in others they appear wholly silvery, the various portions appearing different in color to the view at the same time. Abdomen silvery but the third and fourth segments wholly brownish, sometimes with a round median spot on each. Legs yellowish, shaded with silvery, tarsi blackish or brownish; hind metatarsi yellowish except at distal end. Wings clear, whitish, veins dilute yellowish. Halteres and wing bases pale dilute yellowish.

Four females, Reynosa, Tamaulipas. A small species taken on the windowpane of railroad car, May 4. Described from four dried specimens. *Townsend*

S. venustum Say

Acad. Nat. Sci. Phila. Jour. 1822. 1:28 and Compl. Wr. 2:51

1862 molestum Harris, Ins. Inj. to Veg.
1870 piscicidium Riley. Am. Ent. 2:367

(Synonymy according to Coquillett, 1898)

Male. Velvet-black. The eyes are very large, separated by a single line, reddish yellow, lower half black. Thorax velvet-black, a bright pearlaceous, dilated line each side before, and a large pearlaceous spot behind, sides beneath varied with pearlaceous. Abdomen with an oblique pearlaceous line at base, and two approximated lateral pearlaceous ones near the tip. Tibiae above, and first joint of four posterior tarsi white. Wings with yellow and iridescent reflections. Poisers black, capitulum bright yellow, dilated. Near Louisville Ky. at Falls of the Ohio. *Say, loc. cit.*

Superhumeral gray stripes metallic, no metallic spots between them; mesonotum not vittate with black. *Coquillett*[1]

The following description of the males is based on specimens from Ithaca N. Y. and Battle Creek Mich. Velvet-black. An-

[1]U. S. Dep't Agric. Bul. 10, n. s. 1898.

tennae black, covered with short whitish pile; palpi black, thorax velvety black, with an oblique bluish white metallic humeral spot, the posterior margin also metallic; scutellum velvety black; and pectus black, grayish pruinose. Abdomen deep velvety black; on each side on the margin of the first abdominal segment is a tuft of fuscous hairs, underneath which the segments appear metallic. The posterior part of the venter appears metallic. Legs, black and yellow. The extensor surface of front tibiae, and a basal ring on the middle and hind tibiae, silvery white; the fore coxae, basal half of all femora, tibiae and metatarsi, and sometimes also bases of some tarsal joints more or less yellowish; the rest black. The anterior tibia with a rudimentary spur, middle and hind pair each with two spurs; tarsal claws trifid. Halteres orange-yellow; wings whitish hyaline. Length 2 to 2.5mm.

Female. Black. Antennae black covered with short whitish pile; two basal joints usually yellowish; palpi black with pale hairs; face and front gray pollinose. Dorsum of thorax black, bluish gray pollinose, particularly on the sides and front corners, sparsely covered with very short yellow hairs. Scutellum black, with erect black bristles; pleura black, gray pollinose. Abdomen black, the anterior segments velvety, the posterior ones subshining brown. Legs yellowish, middle and hind coxae brown, tips of femora and tibiae, the whole of fore tarsi, tips of the middle and hind, first and second tarsal joints and usually the whole of the remaining joints, black. Sometimes the femora are wholly black. The extensor surface of all tibiae is silvery white. The first and third joints of the fore tarsi are each provided with a pair of long black hairs near the tip, besides the usual shorter ones. The anterior tibia with rudimentary spur, middle and hind ones each with a pair. Tarsal claws simple. Wings whitish hyaline, the heavy veins yellowish brown, quite yellowish at the base at point of attachment. Halteres pale yellow. Length 2 to 3mm.

This species is very common in the Adirondacks, where it proves to be a great annoyance to travelers. It seems to have a wide distribution, having been reported by Mr Coquillett[1] as occurring in Canada, New Hampshire, New York, Michigan, Minnesota, Wyoming, British Columbia, California, Texas, Louisiana, Mississippi and Florida. I have found it in Ithaca N. Y., and I have seen specimens from Moscow, Marsh and Albion Id., and Battle Creek Mich.

[1] U. S. Dep't Agric. Bul. 10, n. s. 2. 1898.

Larva. Specimens from Wilmuth and Axton N. Y. [Pl.37, fig.1 to 6]. Pale brown with paler incisures; head brown, labrum hairy, with serrated edge; fans with 50 to 60 rays; mandibles with a pair of apical setae; hypopharynx as usual; labrum [fig.6] with middle tooth rather prominent, its ventral surface with five setae in each of the two rows; each of the three branches of anal papillae with a number of lobes.

Pupa. Six branched respiratory filaments; eight hooks curved cephalad on dorsum of each of abdominal segments 3 and 4; four hooks curved cephalad on ventral surface of each of segments 5, 6 and 7; a close transverse row of small caudad projecting spines on dorsum of eighth segment, and a pair of short, blunt tubercles on the anal segment. Cocoon of the wall pocket type.

S. venustum, var. a

Plate 37, fig.8–14

A number of specimens bred from larvae and pupae taken from Fall creek, Ithaca N. Y., differ in the adult stage from venustum as described above in being uniformly smaller (length 1.5mm); having the base of wing brownish and not yellow, and in having the last four abdominal segments of the female a shining black instead of brown. The larva differs as follows: in size averaging less than two thirds that of venustum, labrum with its toothed edge wider in proportion to its size than in venustum, its teeth more nearly of a size, the ventral setae three in each row plus a very small one. The pupa differs in having 10 respiratory filaments in each tuft, the hooks on segment 2 more distinct, and the tubercles on the anal segments apparently wanting.

S. piscicidium (Synonym of venustum) Riley

Am. Ent. 2:367

According to Coquillett this is a synonym of S. venustum; but I have larvae and pupae from Professor Needham, taken at Saranac Inn N. Y., which, though agreeing with Riley's figures of piscicidium, differ decidedly from the larvae and pupae of S. venustum taken by Messrs MacGillivray and Houghton at Axton N. Y. in 1901, and by Professor Comstock at Wilmuth N. Y. Of the adults of the Saranac Inn material I have only alcoholic specimens, hence can not state definitely wherein these differ from S. venustum from Axton N. Y. excepting that it averages a little larger in size. For the present I shall regard it as a variety, though in all the material

of larvae and pupae studied I did not find transitional characters. Should a difference be discovered on the examination of more fresh specimens of both varieties of adults, the specific name of p i s c i c i d i u m must be revived. Riley's description is as follows:

Female. Head velvet-black; eyes brownish; antennae with joints 1, 2, 3 and 11, subequal in length, each of the others half as long. 1 and 2 rufous, 3 to 11 inclusive black and gradually diminishing in thickness to the last, which is fusiform; palpi longer than the antennae, black. Thorax velvety black with faint fulvous pubescence above; halteres opaque and white. Abdomen nine jointed, joints equal in length except the last two, which are smaller and smaller; dorsally velvety black, laterally and ventrally, especially towards the base and at the incisures, inclining more or less to rufous. Legs with the front trochanters white or fulvous, and the middle and hind ones more dusky; the coxae all either rufous or fulvous; the femora all dark, though sometimes (two specimens) the base is paler. Front tibiae with the upper three fourths white, the rest black; hind tibiae with the upper two thirds white, the rest black; middle tibiae with about the upper one half white, the rest black; front tarsi black; middle and hind tarsi with the upper half of first joint white or rufous, the rest black. Wings subhyaline, with the veins fuliginous. Length of the body (in alcoholic specimens) .14 to .17 inch. Mumford N. Y.—Riley

Larva [pl.37, fig.2,5,7]. Pale grayish, slightly darker dorsally. Head of the usual shape, brown with darker margins. Fans with 50 to 60 rays, the longer cilia quite prominent. The apical pair of bristles of the mandibles present; the labrum with a serrated margin; the maxillary palpus with a few setae on last joint and also on base; hypopharynx as usual; labium with the toothed margin comparatively narrow; its teeth nearly uniform in size, with seven setae in each row on the ventral surface [fig.5]. Anal papillae, three much branched lobes.

Pupa. The pupa with eight branched respiratory filaments, with four hooks curved cephalad on ventral surface of each of the segments 4, 5, 6 and 7, those on the fourth being quite small. On the dorsal surface of each of segments 3, 4, 5 and 6 are eight hooks curved cephalad, those of 5 and 6 being very small; and on the dorsal surface of 7 and 8 are a number of hooks curved caudad. The anal segment with two short, blunt spines. The pupal case is of the " wall pocket " type.

In order to obtain characters to separate the adults of the Fall creek, Saranac Inn and Axton varieties of v e n u s t u m ,

a number of them which were nearly ready to emerge were drawn from the pupal skins and examined for distinctive structural characters; but, excepting the difference in size, none were observed. With freshly bred material, perhaps specific characters might be obtained.

The larvae of p i s c i c i d i u m is briefly described by Riley in the paper just quoted.

S. virgatum Coquillett

U. S. Nat. Mus. Proc. 1902. 25:97

Male. Head and body black, antennae and mouth parts dark brown, thorax gray pruinose, mesonotum marked with a narrow median and laterally with a very broad velvet-black vitta (viewed directly from above), mesonotum sparsely covered with short, appressed hairs; abdomen on first six segments opaque, velvet-black, a large silvery white spot on each side of the second and sixth segments, venter near each side with an interrupted yellow vitta on segments three to seven, composed of appressed hairs, on each side of base of abdomen is a large cluster of yellow hairs, and a smaller cluster on each side of segments three to five; femora and front tibiae yellow, their apices brown, middle tibiae brown, a yellow ring beyond the base, hind tibiae brown, the extreme base yellowish; tarsi black, broad base of first joint and extreme base of the second on the middle and hind tarsi light yellowish; wings hyaline, veins along the costa yellowish brown, the others nearly hyaline; halteres yellow.

Female. Differs from the male as follows. Vittae of mesonotum brownish, the median vitta dilated posteriorly, wider than either of the lateral ones; viewed from in front the mesonotum appears whitish pruinose and with two velvet-black vittae; abdomen on the first five segments and sides of the sixth opaque, gray pruinose, and with a velvet-black fascia at bases of three to six, broadly interrupted on six, the middle of which and the portion of the abdomen beyond it is very thinly pruinose and of a dark brown color. Length nearly 3mm. In August; Las Vegas Hot Springs, N. M.

S. vittatum Zetterstedt

Ins. Lapponica. 1844. p.803

(= S. t r i b u l a t u m Lugger)

(According to Coquillett, d e c o r u m Walk. 1848 and a r g u s Will. 1893 are synonyms)

Female. Gray; nearly bare; dorsum of thorax with five black stripes, the median one entire, the intermediate pairs inter-

rupted, the exterior pair spotlike. Each segment of the abdomen with a black dorsal stripe and basally on each side with a black spot, the penultimate segment black. Wings whitish hyaline; halteres white; legs fuscous black, the front side of anterior tibiae, the base of the middle and hind tibiae, and the base of the middle and hind metatarsi white. Length 3mm. *Zetterstedt*

Female. The abdomen gray, bases of segments 3 to 7 or 8 marked with a velvet-black fascia produced backward in the middle and at the ends. Length 2 to 4mm. New York, Minnesota, Nebraska, Kansas, California.

Male. Hind tarsi bicolorous, mesonotum gray on sides and hind margin, center largely velvet-black; without gray streak extending inward from humerus; sides of abdominal segments 4 to 7 with silvery white hairs. *Coquillett*[1]

The markings of the female of this species seem somewhat variable. The thoracic markings are usually quite distinct. The median stripe is nearly of uniform width excepting at the posterior end, where it becomes narrower; the intermediate stripes are *f* shaped, the extremities larger, the intermediate portion usually a hair line, sometimes obsolete; the exterior pair usually elongated spots. The abdominal markings are as described by Coquillett, though occasionally there are additional disconnected, velvet-black lateral spots, one on each side on segments 3, 4 and 7, and a pair on 5 and 6. Sometimes also, owing either to the contracted condition of the abdomen or to the fasciae being narrow, only the black projections of the fasciae are visible on the more posterior segments, giving the appearance of three spots on each. The legs are often gray; the femora and tibiae paler at the base, the tibiae black at tip, the tarsi deep black except basal portion of middle and hind metatarsi. Fore tibiae with one spur, middle and hind with a pair. Tarsal claws of female simple.

Some specimens from Brookings S. D., received from Professor Aldrich, and which are the males of v i t t a t u m , possess the following characters:

Male. Velvety black, antennae and palpi dark brown; dorsum of thorax velvety black with the anterior and lateral margins

[1]Bul. 10, n. s. 1898. p.63.

narrowly, and posterior margins in front of scutellum, widely silvery gray; also two narrow longitudinal gray stripes on dorsum. Or the dorsum might have been described as silvery gray with three very wide velvety black longitudinal stripes, abbreviated behind. Pleura black, bare; scutellum velvety black; metanotum silvery gray; abdomen velvet-black, the sides of first two or three segments of the ventral surface with a silvery reflection in some lights; legs black, the tips of the fore femora, the basal half of fore and hind tibiae (sometimes the middle one also) the basal two thirds of hind metatarsi, and the extreme base of the second hind tarsal joint, yellow. Fore tibiae with a single spur, middle and hind tibiae with each two; tarsal claws tridentate. Halteres bright orange-yellow. Wings hyaline, the vein yellow. Length, 3mm.

In an article by Lugger[1], it is stated that in S. tribulatum the male is much smaller than the female, having very large brilliant, red eyes that meet on top of the head; the body is velvety black with bright golden yellow and blue spots; the female is gray with black markings. This species is said to be most abundant in Minnesota, where it is called "the black fly." No further description is given; the figures of the male and female agree with the description of S. vittatum. Some specimens sent by Mr Washburn of the Minnesota Experiment Station, labeled S. tribulatum proved to be S. vittatum. I have specimens of larvae and pupae which belong to S. vittatum, which were sent to me by Professor Needham, he having obtained them from Mr J. C. Bradley of Philadelphia.

Larva (of S. vittatum). Somewhat mottled gray, the sides of each segment blackish. The larvae and pupae were collected by Mr J. C. Bradley, Philadelphia, 1901. The head is of the usual reddish brown color; the pale yellow antennae long and cylindric, the second joint about one third the length of the first, the third is a pointed process at the tip of the second. The fans have about 40 rays, the cilia being relatively minute. The mandibles are provided with three large apical teeth besides the row of secondary ones; the apical pair of bristles is present. The maxillary palpus has a few spines, and a tuft of a few spines on the basal joint. Hypopharynx and labrum apparently like those of other species. The labium has an elongate middle tooth, those at the end nearly as long, the

[1]Minn. Agric. Exp. Sta. Bul. 48, p.207.

intermediate ones short [pl.35, fig.2], and there are six bristles in each of the two longitudinal rows on the ventral surface. The three blood gills at caudal end are unbranched.

Pupa. The thoracic respiratory filaments each consist of a single main trunk, from which arise eight branches, each of which divides into two, thus making 16 twigs in all [pl.35, fig.1]. Near the basal margin of the last few abdominal segments, are a few caudad projecting dorsal hooks, and on the tip of the last segment is a pair of blunt spines. The pupal case is of the wall pocket type, from which the respiratory filaments of the pupa project. Judging from the number of respiratory filaments of the pupa, the species described by Osten Sacken in *American Entomologist*, volume 2, seems to belong here.

Simulium sp. C. H. Townsend

Am. Ent. Soc. Trans. April 1893. 15:45

The larva and pupa of a species which appears to differ from S. var. p i s c i c i d i u m , are described by Townsend [*loc. cit.*], the only species with which it might be confused. Specific characteristics are as follows:

On the dorsal surface of the head are several rows and groups of nearly concolorous markings . . . Antennae pale, nearly as long as one half anterior width of head, three jointed, first joint very elongate, and narrow, not swollen, slightly curved, with a somewhat faint transverse suture on basal two fifths, cylindric below suture, beyond the suture very slightly and somewhat irregularly narrowing to tip; second joint narrower than tip of the first, straight and of equal width except slightly widened at base, a little more than one third as long as first joint, and with two small, triangular budlike processes, one on each side at the base, springing from the junction of the two joints and approximated to the second joint; third joint extremely small, short, minute, triangular, but little longer than wide, about the same shape as the minute processes at base of second joint. Fans consisting of about 60 scythe-shaped rays each, microscopically thinly hairy . . . Mandibles furnished with teeth on inner side at apex; four large teeth on apex, nine or 10 teeth behind these, gradually decreasing in size, except that the second of these is larger than the first, a large tooth still behind these; with a small one directly beside it . . . Thoracic proleg with at least 30 obliquely longitudinal rows of hooks, and probably more; at base of these there is a marginal transverse row of bristles on side toward body (the leg being flexed forward) extending around laterally, but wanting on outer surface . . . Blood gills a soft, retractile, primarily three branched organ just anterior

to these on dorsum, each branch being subdivided into five smaller branches or papillae. Length 11–13mm. Width of head about 1mm. Of anal portion $1\frac{3}{5}$mm. [The figure given by Townsend shows the mandible with the apical bristles.]

Pupa. General color pale brownish yellow on the thoracic portion, abdomen darker; head, wing and leg cases, and filaments pale yellowish, the head sometimes brownish; prothoracic filaments arising from a single stalk on each side, which branches at base into usually eight filaments; these do not subdivide. Third and fourth abdominal segments with five or six brown hooks or spines on posterior margin of dorsum. Length excluding filament, 4.5mm.

Cocoon or case. Massed in coral-like aggregation. Open at top but enveloping all of the pupa, except the filaments or the extreme anterior portion of the hunchbacked thorax. Length 4mm. Abundant in a small stream in one of the branches of Grand cañon. July 8–11, 1893. This branch or side cañon, is one down which the Hance trail leads, being situated about 55 miles in a straight line n. n. w. of Flagstaff Ariz.

Some larvae which I received from Professor Needham, to whom they were sent by Professor Cockerell from Las Vegas N. M., may belong here. The general color however is reddish and it is only about 7 or 8mm in length. The labium has a more irregular outline than most of the other species [pl.35, fig.10]. The mandibles have a pair of apical bristles; labrum, hypopharynx, and mandibles resemble those of other species; on the head are six blotches arranged symmetrically about a median axis; each blotch consisting of two or three confluent black spots.

Simulium, species

Plate 35, fig.4-7

Some specimens of larvae and pupae sent me by Professor V. L. Kellogg, of Stanford University, collected in Santa Cruz mountains, differ from all larvae and pupae so far described.

Larvae. Length 6 to 7mm. Pale brownish gray above, with whitish venter and suture. Head whitish above, the margins brown. The fans with about 30 rays, its longer cilia conspicuous. The secondary fan at the base of the peduncle of the larger fan and usually composed of curved hairs, consists here of coarse, straight hairs. The mandible with apical pair of bristles [fig.6], maxillary palpus with some stout setae, labrum

and hypopharynx as with other species. Labium with its teeth nearly of uniform size. Five or six setae in each of the two ventral rows [fig.7]. Anal papillae were retracted in all the specimens examined; hence I could not determine the number. The pupa has 12 respiratory filaments in each tuft [fig.4]. The abdominal hooks, curved cephalad, are as follows: three or four on ventral surface of each of segments 5, 6 and 7; eight on the dorsal surface of 3, 4 and 5; and a pair of very short, blunt tubercles on the anal segment. The pupal case is shaped as shown on plate 35, figure 5.

Family CULICIDAE

Mosquitos

The Culicidae, or mosquitos, have been studied and described by Dr Howard, Mr Coquillett and others in this country, and by Theobald, Ficalbi, Ross, Nuttall, Shipley, Grassi, and others in Europe in such detail that it is unnecessary to repeat here that which has already been done. I shall therefore content myself with merely giving a synopsis of the generic characters of the larvae, pupae and adults, and describing a few forms such as have come under my notice, together with figures illustrating details of structure. An extensive bibliography is given by Ficalbi in Bullet. d. Soc. Ent. Italiana, 1896, to which the reader is referred. Nuttall and Shipley, in the *Journal of Hygiene*, 1:75, give a bibliography of the more recent work. I shall therefore give only a few references to articles which occur in American literature and a few of the more important of the works of Europeans.

Brief bibliography of the biology of the Culicidae

Coquillett, D. W. (1900) Table to the genera and species in U. S. Dep't Agric. Cir. 40, ser. 2, bul. 25, n. s., and table in Howard's book, Mosquitos (1901).

Dyar, H. (1901) Life History of Uranotaenia, and Descriptions of the Larvae of Two Species of Culex and One of Aedes. N. Y. Ent. Soc. Jour. Dec. 1901.

—— (1902) Illustrations of the Larvae of North American Culicidae. 2, 10:194 and 3, 11:23. N. Y. Ent. Soc. Jour.

—— (1902) Notes on Mosquitoes on Long Island N. Y. Ent. Soc. Wash. Proc. 5:45.

—— (1903) Notes on Mosquitoes in New Hampshire. Ent. Soc. Wash. Proc. 5:140.

Ficalbi, E. (1899) Venti specie di Zanzare. Soc. Ent. Italiana Bul.

—— (1896) Rev. sistematica d. fam. delle Culcidae Europee. Soc. Ent. Ital. Bul.

This contains an extensive bibliography.

Giles, G. M. (1900) Gnats or Mosquitoes; a compilation of the descriptions of the mosquitoes of the world.

Howard, L. O. (1900) U. S. Dep't Agric. Cir. 40. ser.2

—— (1900) U. S. Dep't Agric. Div. Ent. Bul. 25, n. s.

—— (1901) Mosquitoes. McClure, Phillips & Co.

This gives the most complete account we have of the biology of mosquitos.

Meinert, F. (1886) De eucephale Myggelarver. in Vidensk. Selsk. Skr., 6. Raekke, naturvidensk. og math. Afd. 3.4.

Contains about 60 quarto pages and two plates on the biology and structure of the Culicidae.

Nuttall & Shipley (1901) Structure and Biology of Anopheles. Jour. of Hygiene, 1:75.

Osten Sacken, C. R. (1868) Am. Ent. Soc. Trans. 2:47, and Western Diptera, p.191 (1877)

Smith, J. B. (1902) Ent. News. 13:268 and 299.

—— (1902) N. Y. Ent. Soc. Jour. 10:10.

Theobald, F. V. (1901) Monograph of the Culicidae. 2v.

With atlas of 37 colored and 5 photographic plates.

Weissmann, A. (1866) Die Metamorphose der Corethra plumicornis.

Also papers in the reports of the various state experiment stations, by Lugger, Osborn. Herrick, and others.

The mosquitos are small to medium sized flies, characterized by the projecting proboscis (sometimes lobed) and by the plumose antennae of the male. The head is small, round; eyes reniform, and ocelli are wanting. The antennae are threadlike, composed of 15 joints, counting the disklike base; the first joint is thick, the following joints small, round and beset with whorls of hairs, forming in the male a long, dense plumosity; the last two joints in the male are slender and bare, or nearly so. The thorax is ovate, arched, but not projecting over the head, without transverse suture, scutellum narrow; metanotum arched. Abdomen long and narrow, somewhat flattened, composed of eight segments; male genitalia prominent, ovipositor short, legs long and slender, the coxae not elongated; the tarsi long. Wings long and narrow, with numerous veins; the hind margin fringed, the costal vein extending all around the wing, and in all known American forms the veins are covered with scales. Venation as in the figures.

The larvae are known as "wrigglers." The head is fully differentiated and usually has eyes; the mouth is usually thickly

ciliated with hairs, by means of which a current of water is produced that brings little particles of food within reach. At the posterior end of the body is usually a single breathing tube, or there are two tubes opening to the exterior on the dorsal surface of the last segment. The segment behind the head is without prolegs.

The pupae are free swimming, and very active. The breathing tubes are situated at the sides of the thoracic segments. The abdomen terminates in two leaflike appendages, that act as propellers; but in general the pupae remain near the surface, except when disturbed.

KEY TO GENERA OF CULICIDAE OF THE NORTHERN STATES

Larvae

1 The last abdominal segment with a single dorsal breathing tube, through which may be seen a pair of large tracheae.....(4)
Last segment without long breathing tube.....(2)

2 Last segment dorsally with a flat area in which may be seen two spiracles .....(3)
Last segment usually with hooks, no spiracles apparent. Larva transparent, glasslike.....Corethra

3 Large species with the anal segment bladderlike. Mandibles strongly developed [pl.41, fig.1].....Peloreмpis, gen. nov.
Species of medium size with anal segment cylindrical...Anopheles

4 Antennae pendant and ending with four large curved spines. Mochlonyx (Europe)
Antennae not pendant.....(5)

5 Antennae fold back against head and terminate in 2 or 3 claws [pl.40] .....Corethrella
Antennae usually only with a few small erect bristles and one or two pointed processes.....(6)

6 With brush of hairs projecting forward from the mouth.....(7)
Brush projects laterad from the mouth. Mandibles long and sharply toothed; large species about 10mm long..... Psorophora (ciliata)

7 No ventral brush on last abdominal segment.....(10)
Last segment with ventral brush.....(8)

8 Anal blood gills dilated; lateral comb of eighth segment a single transverse row of spines with elongated bases; anal segment without hair tufts before barred area..... Stegomyia (fasciata)
Anal blood gills slender.....(9)

9 Anal blood gills sharply pointed, air tube spines with one tooth; lateral comb of eighth segment a few large spines in a single or partly double row.....Aëdes (fuscus)
Not as above in all respects.....Culex

10 With two anal blood gills; the two lateral combs of the air tube wanting. Small species; found in water in the pitcher plant ..... Aedes (smithii)
With four blood gills; with stellate hairs on the abdomen. Small species ..... Uranotaenia (sapphirina)

The southern genera Toxorhynchites, Megarrhinus and Conchyliastes are not included in the above table; their larvae have never been described as far as I am aware.

Pupae

1 Swimming paddles, two pointed lobes [pl.40] ..... Corethrella
Swimming paddles rounded ..... (1a)
1a The respiratory tube of the thorax spindle-shape, pointed at the apex ..... (2)
Tube cylindric or trumpet-shape ..... (3)
2 Both inner and outer margins of the swimming paddles with reinforcing ribs, but without spine at the apex ..... Corethra
Only the middle rib present; last segment short, seventh segment considerably longer than either the sixth or eighth ..... Mochlonyx (Europe)
3 Apex of swimming paddle ending in a small spine ..... (5)
Apex with a few cilia or short hairs ..... (4)
4 Small species 2 or 3 mm in length; last two segments with a thick brush of hairs on each side ..... Aedes (smithii)
Large species, 7 or 8 mm in length ..... Psorophora
5 Large species at least 8 mm in length ..... (6)
Moderate or small sized species ..... (7)
6 Apex of swimming paddle ending in a short, sharp spine .... Peloreмpis gen. nov.
Apparently without a spine (?), with a pair of stellate hairs on the first abdominal segment ..... Psorophora
7 Thoracic breathing tubes much elongated, about 12 times as long as wide. Abdomen with a number of stellate hairs.. Uranotaenia (sapphirina)
Tubes not elongate ..... (8)
8 Tube about as wide as long ..... Anopheles
Tube longer than wide ..... Culex

Imagos

1 Proboscis short, not much longer than the head ..... (2)
Proboscis elongate, longer than the head and thorax taken together ..... (4a)
2 Metatarsus longer than the following joint ..... (3)
Metatarsus shorter than the following joint.. Mochlonyx (Europe)
3 Species less than 4 mm in length; tarsal claws simple ..... (4)
Large species, 10 or more in length; tarsal claws bifid ..... Peloreмpis gen. nov.
4 Antennae verticilliate with hairs (i. e. in whorls) ..... Corethra
Antennae wholly covered with hairs, legs densely hairy .... Corethrella

4a Legs bearing many erect scales. Large species.....Psorophora
Legs without these scales.....(5)
5 Thorax with metallic blue scales; small species; male with but a single curved claw on the middle leg; palpi of both sexes two jointed and short.....Uranotaenia (sapphirina)
Thorax not so marked.....(6)
6 "Hind feet black, their apexes snow white." Male palpi long, in the female short.....Conchyliastes
Not as above.....(7)
7 Palpi elongate.....(8)
Palpi short.....(9)
8 The fourth fore tarsal joint shorter than the fifth, about as long as wide. Palpi elongate and pointed.....Culex (males)
Fourth fore tarsal joint longer than wide. Male palpi with enlarged apical joints.....Anopheles
9 Small species with two jointed palpi; the second joint conical..Aedes
Medium sized species, with four jointed palpi, its apical joint cylindrical.....Culex (females)

Of the southern genera, Megarhinus and Toxorhynchites may be known by their strongly curved proboscis and green and bluish colors. Stegomyia resembles Culex, but has the thorax marked with lines of silvery scales.

Subfamily CORETHRINAE

Genus CORETHRA Meigen

This genus together with Corethrella, Mochlonyx and Pelorempis, nov. gen. forms the subfamily Corethrinae, which is distinguished from the remainder of the family by the comparative shortness of the proboscis. There are but 15 or 16 species in the genus, four or five of which occur in North America. The life history of some of the species has long been known. Some of the works on the biology of Corethra are:

1844 Staeger. Naturhist. Tidsskr. I. R. 2. B. 549, 600. Corethra fusca.
1863 Weissmann, Dr A. Die Metamorphose der C. plumicornis.
1884 Herrick, A. Minn. Geol. Nat. Hist. Sur. p.10. C. appendiculata.
1886 Meinert, F. De Eucephale Myggelarver, p.30 to 53. With bibliography.

Generic characters

Usually delicate, moderate sized species of the appearance of a Chironomid, but distinguished by its many veined wing. Head transversely oval, epistome somewhat projecting; pro-

boscis with round labellae, and only one half as long as the incurved, four jointed palpi; antennae 15 jointed, the basal joint disklike, the following joints each thickened at the base, in the male plumose, the last two joints elongated and slender; the eyes crescent-shaped. Thorax highly arched, without suture; scutellum rather small; metathorax prominent. Abdomen long and slender, somewhat flattened, from the base to the middle gradually widening, and again becoming narrower toward the end; hypopygium prominent, the ovipositor projecting. Legs long and slender, the metatarsus longer than the following tarsal joint; claws small and simple. The wing veins and the posterior margin thickly haired; venation as in the figures.

List of the North American species

albipes n. sp. *See* p. 398. Ithaca N. Y.

appendiculata Herrick, Minn. Geol. Nat. Hist. Sur. 1884. p.10. Known only in the larval and pupal stage and may belong to some other genus.

plumicornis Fabricius var. americana. (See subsequent pages for synonymy)

Saranac Inn N. Y., Lake Forest Ill., White mountains, N. H. (Slosson), Minnesota (Herrick)

punctipennis Say, Acad. Nat. Sci. Phila. Jour. 1823. 3:16, and Compl. Wr. 2:43. Wiedemann, 1:14. Pennsylvania and New Jersey.

trivittata Loew, Berl. Ent. Zeit. 1862. p.186. (Centur. 2, 1). Maine, California, Alaska.

This is a synonym of punctipennis according to Giles in his work *Gnats or Mosquitoes.*

The larvae of but three North American species are known. To assist in separating the species which may be found later, I have given in the table the characters of some of the European species also.

1 Antennae shortish and with a spine outwardly; anterior part of the head is spiny; club-shaped bodies at the caudal end instead of claws.....appendiculata Herrick
Antennae with four spines.....(2)

2 Ventral comb of the last abdominal segment with a row of brushlike hairs; each consisting of five to seven bristles (European species).....fusca Staeger
Ventral comb consisting of a number of separate feathered hairs [pl.39, fig.6].....(3)

3 The pair of leaflike appendages [pl.39, c. fig.4] lying cephalad of the labrum (*l*), at least one half as wide as long; ventral comb of the last abdominal segment with 25 hairs.....(4)

Appendages over the labrum lanceolate and four or five times as long as wide, ventral comb of last segment with 21 hairs (European) ..... pallida

4 "One of the four antennal bristles markedly shorter than the rest" ..... plumicornis (Europe)

The four antennal bristles of equal length; anal segment with four dorsal hairs..... plumicornis, var. americana

The larva of C. trivittata described by Dyar in N. Y. Ent. Soc. Jour. 10:201 is said to have but 2 dorsal hairs on anal segment.

Pupae

"Extraordinarily elongate abdomen which terminates in two paddlelike appendages, loosely ciliate outwardly". appendiculata

Abdomen of moderate length, see figure; paddles with short cilia on the inner margin..... plumicornis

Imagos

1 Wings with dark markings..... (2)

Wings unmarked ..... (4)

2 Wings with several cross bands. Length of insect 1.5mm.... Corethrella brakeleyi

Wings with numerous dark spots..... (3)

3 The apex of both femora and the tibiae, and the base also of the tibiae, black, antennae with subfuscous hairs. Length 4.5mm ..... trivittata

Legs punctate with numerous small brown spots. Antennae with yellowish hairs..... punctipennis

4 Yellowish white species; legs white and spotless..... albipes n. sp.

Pale brown or reddish yellow species..... plumicornis

Judging from the description, the larva of appendiculata differs greatly from all the known Corethra larvae, and F. Meinert in *De eucephale Myggelarver* says in regard to its pupa that the figure given by Herrick resembles that of a Chironomid rather than a Corethra. In the same paper Meinert expresses the opinion that fusca is but a darker variety of plumicornis; and attributes the differences in the larva to an error of Staeger, assuming that the latter described some other species.

Corethra appendiculata Herrick

Minn. Geol. Nat. Hist. Sur. 1884. p.19, pl.5.

The adult not bred. Larva as follows:

Form is more slender than plumicornis. The tracheal vessels are of a different form and color, and viscera have obvious differences. . . Shape of the head is slender and attenuated toward insertion of the antennae. Antennae are shortish

and have a spine outwardly. The cuticular appendages have an unusual form, as has the labrum. The anterior part of the head is spiny. The armature of the end of the abdomen is peculiar. The posterior rudimentary appendages are of a different form, and the claws are replaced by club-shaped bodies. A curious appendage below is indicated in the name. The pupa has an extraordinarily elongate abdomen which terminates in two paddle-shaped appendages, loosely ciliate outwardly. From Lake of the Isles near Minneapolis Minn. *Herrick* [*loc. cit.*]

Corethra plumicornis Fabricius

Plate 39

Ent. Syst. 1794. 4:246-58

The following synonymy is according to Schiner, *Fauna Austriaca*, 1864. 2:624.

1776 cristallina Degeer (Tipula), Ins. 6:149, 20
1787 pilicornis Fabricius (Tipula), Mantissa Ins. 2:325-49
1788-93 hafniensis Gmelin (Tipula), Syst. Natur. 2826, 108
1794 plumicornis Fabricius, Ent. Syst. 4:246-58
1809 (?) lateralis Panzer, Fauna Ger. 109:16
1818 plumicornis Fabricius, Meigen, Syst. Beschr. 1:15. 1
1864 plumicornis Fabricius, Schiner, Fauna Austriaca. 2:624

C. plumicornis, var. americana

Male. Reddish brown; abdomen yellowish; the antennal joints yellow with brown tips, basal joint brown; the hairs pale brown; the front, the upper surface of the proboscis, and the palpal joints brown; the incisures of the latter yellow, the vertex, the cheeks and the underside of the proboscis and neck pale yellow; thorax pale brown above with three dark reddish brown stripes, the middle one divided by a fine, pale brown line; the lateral stripes abbreviated anteriorly, the median one posteriorly; the pectus and the margins of the pleural and jugular sclerites reddish brown; scutellum pale brown, metathorax dark brown; abdominal segments subequal in length except the first and last, which are less than one half of the others. The dorsal surface is brown with pale yellow incisures. The brown coloring is darkest anteriorly, gradually becoming paler caudad, so that the posterior margin of the segment is almost as light in color as the incisure. This is particularly true with segments 3, 4 and 5. On segment 6, 7 and 8 the brown color is almost wanting excepting a triangular lateral spot which is prolonged caudad in a fine line. The outline of this spot, however, is not distinct, but is blended in with the color of the dorsum. A pair of very small pale yellow spots with a narrow brown border are more

or less distinctly visible on each segment. The hypopygium consists of two jointed hooks, is pale brown in color, nearly as long as an abdominal segment [fig.8]. Venter and the legs are pale yellow, the last two or three tarsal joints slightly infuscated. Legs and abdomen densely but delicately haired; wings yellowish, the veins scarcely dark; venation as in figure 10; halteres pure white. Length 5½mm.

Female. Differs from the male in the following particulars. Antennae entirely yellow, basal joint, palpi and upper surface of proboscis with a tinge of brown; frontal spot brown; scutellum with a fine median line and its posterior margin pale yellow; abdomen yellow, dorsal surface with a tinge of brown, specially on the posterior margin. The two little white spots with pale brown margins also present on each segment. Anal segment brown, genitalia yellow, venter, legs, halteres etc. as with the male. Wings as in figure 9. Length 5mm. Described from alcoholic specimens. New Jersey, Illinois, New York, Minnesota.

Larva differs from Meinerts description [*loc. cit.*] of the European p l u m i c o r n i s in the following particulars. The four long bristles of the antennae are of equal length, while in the European form one is distinctly shorter than the rest; the head in all alcoholic specimens is more sharply constricted from the thorax. In Weissmann's figure the spines of the antennae are shown of equal length.

The larva is colorless, in alcoholic specimens pure white; the large eyes, the pair of air sacs in the thorax and in the seventh abdominal segment are black and the tips of the mandibles brown. The head is somewhat elongate, subconical, the antennae pendant [fig.4*a*], each with four long bristles of equal length. Caudad of these are 10 filaments, five on each side of the median line [fig.4*b*]; these are the filaments of the third metamere of Meinert. Then comes the pair of leaflike appendages, appendages of the third metamere of Meinert, [fig.4*c*]; following which is the labrum.

The labrum [fig.4*l*] is an elongate fleshy, fingerlike process, terminating in several tufts of hair. The two ventral tufts each with from 20 to 25 coarse hairs. At the base and somewhat cephalad of the mandibles [fig.4*m*] are the fans [*f*] each consisting of from 18 to 22 long, coarse hairs. The mandibles [*m*] have four or five teeth, two stout spines anteriorly, and a serrate posterior margin. Closing in the lateral posterior margin of the mouth are the maxillae [fig.*x*]; fleshy lobes, each with a long, jointed appendage anteriorly and two short stout spines. At the posterior border of the mouth is the labium [*l*] with

two short spines. The thorax is cylindrical, of greater diameter than the abdomen; the two black air sacs distinctly visible. The abdomen is of circular cross section, tapering gradually toward the caudal end. Segments are subequal in length except the first, which is somewhat shorter; each provided with a few short hair tufts. The black air sacs of the seventh segment are large and distinct. On the ventral surface of the anal segment [fig.6] is a fan of 25 long, feathered hairs, arranged on a keel or ridge. At the apex of this segment are four elongate blood gills and four long, feathered hairs, and near the apex, arranged in a transverse row on each side, is a comb of about 15 small, short hooks, curved cephalad; attached to the base of each hook is a delicate transparent, sickle-shaped blade, with a serrate inner margin; the surface of the blade is covered with transverse ridges, which give it the appearance of a curved pectinate hair, owing to its transparency. The combs are difficult to see. Ventrad of the combs is a pair of large blunt hooks curved cephalad.

The pupa [fig.2] resembles that of Culex, pale yellow in color, the thorax with three brown longitudinal stripes, the middle one divided by a yellow line. Eight abdominal segments are present, the first and eighth shorter than the others, and on each are found a few scattered hairs. Attached to the eighth segment are the swimming paddles [fig.5]; these differ from those of Culex in having, besides the median rib, each margin also supported by a rib. On the inner rib is a row of cilia. The breathing trumpet [fig.20] is spindle-shaped, covered with a close network of pentagonal and hexagonal figures. The small aperture is at the apex.

Corethra punctipennis Say

Acad. Nat. Sci. Phila. Jour. 1823. 3:16. and Compl. Wr. 2:43. Wiedemann. 1828. 1:14

Whitish; wings and feet punctured with fuscous. Inhabits Pennsylvania.

Hair of the antennae yellowish white, the centers of the whorls being fuscous; the shaft of the antennae has a decidedly annulated appearance; eyes black; thorax with three pale yellowish brown abbreviated, broad lines, the middle one originating before and terminating at the center of the disk, the lateral ones originating rather before the middle; feet with numerous small brown punctures; wings with many very obvious brown spots.

Size of C. c u l i c i f o r m i s Degeer (i. e. 6mm)

Corethra trivittata Loew

Berl. Ent. Zeit. 1862. Centur. 2, p. 186

Male. Pale yellowish, with three thoracic stripes, the metanotum, fasciae of the abdomen, with apical rings of the femora, and basal and apical rings of the tibiae, fuscous black; the wings with cinereous spots. Length 4.3mm. Wing 5mm.

Pale yellowish, with long, mostly subfuscous pile. Antennae black, annulated, densely verticellate with subfuscous hairs. Dorsum of thorax with three black stripes, the double median one posteriorly, the lateral stripes anteriorly, much shortened. The sides of the scutellum fuscous; metanotum fuscous black; the abdomen fasciate with fuscous. Legs pale yellow; the tarsi from the tip of the first joint pale fuscous; an apical ring on each of the femora and an apical and a basal ring on each tibia is blackish. The wing variegated with some small cinerous black spots. Maine, California, Alaska. (*Osten Sacken*)

This is a synonym of C. p u n c t i p e n n i s according to Giles in *Gnats or Mosquitos.*

The larva and pupa of this species are described by Dr Dyar.[1]

The only apparent difference between this and the larva of p l u m i c o r n i s seems to be that in the former species there are but two hairs on dorsal surface of anal segment while there are four in p l u m i c o r n i s.

Corethra albipes nov. sp.

Female. Entire insect pale yellow in ground color; head and antennae wholly pale yellow; dorsum of thorax with three longitudinal stripes pale buff in color, the lateral ones abbreviated anteriorly, the median one posteriorly, the latter divided longitudinally by a pale yellow line. These stripes all narrowly margined with brown, and on the anterior and outer margins of the lateral stripe are a few tiny black specks. Scutellum with a pale buff posterior margin; pleurae yellow, sparsely sprinkled with small, irregular black specks; abdomen yellowish white beneath, pale buff colored above, lateral margin sparsely sprinkled with small irregular black specks; legs pale yellowish, unspotted, fourth and fifth tarsal joints slightly darkened; claws simple; legs and abdomen covered with long, loose yellow hair; wings uniformly pale yellowish, the veins, the hair on them, and the halteres same color. Venation as in plate 39, figure 11. Length 5½mm. Ithaca N. Y. August 1901.

[1] N. Y. Ent. Soc. Jour. 10:201.

CORETHRELLA Coquillett

N. Y. Ent. Soc. Jour. 10:191

Plate 40

Through the kindness of Prof. John B. Smith of New Brunswick N. J. from whom I received specimens of larvae, pupae and adults, I have been enabled to make a study of this interesting species, which in the adult stage has already been described under the name of Corethra brakeleyi by Mr D. W. Coquillett.

From Corethra it differs in the following particulars:

In both the male and female the thorax, scutellum, abdomen and legs are sparsely covered with long coarse hairs, many of these being as long as the fore metatarsus. The antenna of the male is thickly covered with long hairs arranged all along the shaft excepting on the apical half of the 13th, and all of the 14th and 15th, which have only short hairs. The 15th or apical joint is slightly enlarged and conical [fig.8]. The antenna of the female has a circlet of a few long hairs at the base of each joint and another irregular circlet of somewhat shorter hairs on the middle of it.

In Corethra, at least in those species with which I am familiar, the male has one circlet of many long hairs at the base of each joint, standing nearly at right angles with the shaft. In the female these hairs are fewer and shorter; the second circlet of hairs wanting. In a balsam mount of Corethrella the 15 antennal joints can easily be counted. The eyes are reniform; the palpi and proboscis are short, the former about twice as long as the latter; the metatarsus is longer than the following joint and the tarsal claws [fig.7] are simple and much curved.

Corethrella brakeleyi Coquillett

Larva. The larva resembles that of Mochlonyx much more closely than that of Corethra; it differs from the former in having the antennae attached near the middle line of the head at the extreme cephalic end, hinged so that they move in a horizontal plane, and normally lie folded back against the side of the head, as shown in figure 1 and 2. The head is transversely oval. The antennae [fig.3] have three long curved spines and

one very short one at the base. Of the longer spines one is somewhat longer than the other two. The dorsal sclerite of the head [fig.1*d*] is somewhat quadrangular in shape, and is provided at its cephalic end with six setae, the median pair being quite small. The lateral sclerites [fig.1 and 2*b*] are nearly hemispherical, with a small black pigment spot on the dorsal surface near the anterior margin; just cephalad of this is a stout seta, laterad of it is a long slender one, and mesad of it a small irregular area of ommatidia. On the middle of each lateral sclerite, arranged in a single transverse row, are about 12 stout spines projecting cephalad, and immediately in front of this row are two or three long slender setae. At the base of each antenna on the frontal sclerite is another seta.

The labrum is a transversely oval piece [fig.4] which is attached at the cephalic margin of the head and hangs flaplike downward and backward over the mouth; its free end provided with two curved, pale yellow spines, between which are several rows of flattened, short, yellow, forked spines. At the base of the labrum are two pairs of rather long, curved setae, and on the center are two pairs of very short, delicate ones.

The mandibles [fig.2 *md*, 5 *md*, and 6] move in a horizontal plane and when folded down are visible only from the ventral aspect. On the inner (mesal) margin near the apical end is a row of seven stout black teeth; on the dorsoapical margin are two stout flattened spines, which, when the long axis of the mandible is parallel to the body, projects mesad nearly at right angles to the long axis of the body. Also on the dorsal surface, a little apicad of the middle are two unequal long and very stout setae; and proximad of these are seven long and one short lanceolate spine attached to a small crescent-shaped basal piece. When viewed from the ventral surface [fig.5] two slender setae may be observed near the lateral margin.

The maxillae [fig.5*mx*] are two lobed. One is of irregular shape, about as long as wide, articulated at its base, with a seta at the apex, and having a small palpus with three or four pointed processes a little laterad of this seta. On the mesal margin are a number of long stout, setae, and long slender hairs. The second lobe [*mx*, *i*], ventrad and mesad of the first, is elongate with a stout seta on the anterior mesal margin. No suture between it and the head sclerite is visible. It may in fact, be a cephalic prolongation of the lateral sclerite of the head. The labium [fig.5*l*] is immovably joined to the ventral sclerite of the head, no separating suture being visible. Its cephalic margin has about 16 stout black teeth, alternating long and short.

The hypopharynx (not shown in the figure), is tonguelike, and lies immediately dorsad of the labium on the floor of the mouth cavity. It is about as wide as the toothed portion of the labium, its anterior margin provided with a fringe of pale, short, fingerlike processes, which barely project beyond the edge of the labium when viewed from below, and is not visible without dissection.

The thorax [fig.1] is transversely oval, not as wide as the head, with the three segments quite distinct. On the lateral margins of each segment are a few tufts of long laterad projecting setae, those on the second and third segments being longer and more numerous than those of the first, and inserted at the tips of fingerlike processes.

The abdomen [fig.1] is nine segmented with long setae on the margins; the setae of the anterior segments being longer than the posterior ones. The tufts of setae of the first and second abdominal segments are inserted on lobular processes like those of the thorax. The eighth segment is shorter than those preceding it; the ninth is slender and cylindric, and makes an angle with the long axis of the body. At its apex are four small blood or tracheal gills, dorsad of which are a pair of long setae, and ventrad, a tuft of them.

Projecting from the caudal margin of the dorsal surface of the eighth segment is the breathing tube, a cylindric tube, as long as, or longer than any abdominal segment, its diameter being less than half its length. At the apex of the tube are several setae, and triangular flaps to cover the aperture.

The color of the head is brown, that of the thorax and abdomen grayish with white incisures. On the dorsal surface of each abdominal segment, surrounded by the whitish field and caudad of the incisure, is an oval, brownish spot. [*See* fig.1]

Pupa. The pupa [fig.10] resembles that of Culex, but differs from it and from other Culicidae known to me, in lacking the broad swimming paddles. In place of them, there are two pointed processes, each with three spines at the apex and a single one laterally near the middle. The breathing trumpet as in Culex, the plane of the margin being quite oblique, but on the rim of the inner side is a little rounded projection. Each abdominal segment has several pairs of setae, the median pair quite stout, the intermediate pair very short and slender and the one or two laterals long and very delicate. In addition to the laterals, there is a longitudinal lateral fringe of very delicate hairs, and the lateral margin is serrate.

Imago. This has already been well described by Mr D. W. Coquillett; and the description is reproduced below.

In addition to the generic characters which have been pointed out, I may say that the wing is heavily fringed with long hairs. and the veins are covered with scales. The venation is shown in fig.9.

Of the life history Professor Smith has given an account in the *Canadian Entomologist* for 1902.

Corethrella brakeleyi Coquillett

Ent. News. March 1902. p.85

Male and female. Dark brown, the antennae, halteres, knees and tarsi yellow, plumosity of male antennae yellow, mesonotum opaque, gray pruinose except three narrow vittae and a few spots near the humeri, hairs of thorax brownish, those of the abdomen yellow, tibiae and tarsi bearing many long hairs; first joint of front tarsi slightly shorter than the tibia; wings whitish hyaline, marked with a brown cross band near one third and two thirds its length, the first one oblique, the second band produced triangularly near middle of its inner side. costal margin on each side of this band strongly tinged with golden yellow, fringe white, marked with a brown spot at posterior end of each cross band and on either side of the extreme wing tip. Length, 1.5 mm.

One male and three females, bred jointly, Aug. 12 to 14, by Mr J. T. Brakeley and Prof. J. P. Smith, Habitat-Lahaway N. J.

PELOREMPIS nov. gen.

Two peculiar larvae were found in a pail of cold spring water at Saranac Inn by Professor Needham, June 1900. One of them was kept till the fly emerged; the other till it had changed into a pupa. Both the larva and adult differ so much from all the species of the Culicidae that a new genus is necessary to contain it.

Female. Large species resembling P s o r o p h o r a in general appearance. Head rounded; occiput strongly developed; proboscis a little longer than the hight of the head with rounded labellae; palpi longer than the proboscis, four jointed (not counting the small basal joint [*see* fig. 10, 11]; the two end joints each longer than the preceding; antennae 15 jointed, the basal joint disklike, the second one short and thick, the rest, including the apical one, small, subequal in length, verticillate with a few hairs of moderate length; eyes kidney-shaped, much cut out around the base of antennae, separated from each other on top of head by only a narrow space; ocelli wanting; thorax

well arched, transverse suture wanting; scutellum narrow, metanotum well developed; abdomen long and narrow, eight segmented besides the anal segment; genitalia inconspicuous; legs long and slender, with fine short hairs, metatarsus nearly as long as the following four joints taken together; claws slender, each with a single tooth on the under side; wings long and slender, extending almost to the margin of the eighth abdominal segment; the margins, and veins except the true cross veins and the first anal, covered with flattened hairs. Venation as in the figure; anal angle obtuse, posterior lobe prominent and rounded. Halteres free.

Pelo[illegible]mpis americana nov. sp.

pl.41

Female. Antennae when flexed downward reaches just a trifle beyond the outstretched palpi. The upper surface of the epistome is brown, yellowish on the sides, the labrum pure white. The labium, which is somewhat prolonged beyond the labrum is brown beneath; this color extends to near the lobelike tip. The lobes are hemispherical and pale yellow, covered with blackish or dark brown bristles. Black hairs cover both the upper surface of epistome and the under surface of labium, and a few bristles on inner eye margin. The front is pale yellow on the lower part, and brown on the upper; the vertex is brown; back of head yellow; palpi brown, the articulations and all of the last two joints yellow, covered with black hairs; antennae reddish brown, the two basal joints and all of third joint except tip, and bases of all the others pale yellow, its hairs black. Thorax yellowish brown; the anterior margin of thorax, a spot on each side of it, four dorsal stripes, and a spot over the root of each wing reddish brown. The dorsal stripes are wide, the median pair only separated by a fine line much abbreviated posteriorly; the lateral stripes abbreviated anteriorly. Scutellum, pleura, and metanotum yellow, the latter with a triangular spot of brown anteriorly, which is prolonged backward into a fine median line; pectus reddish, or reddish brown; thorax and abdomen nearly bare; abdomen eight jointed plus anal segment, yellow, each segment with a reddish brown fascia which covers the posterior third of the segment, excepting its extreme edge. The anterior margin of each fascia produced forward at the middle and the sides till the brown color nearly reaches the anterior margin of the segment. The anal appendage consists of four rounded, inconspicuous pieces. The venter is paler than the yellow of the dorsum. Legs yellow, a few small spots on the coxae, the tip of all femora, base and tips of all tibiae and the tarsi except the

basal one half of the metatarsus are reddish brown. The brown of the tarsi seems to be due to the presence of the numerous brown hairs rather than to ground color. Tarsal claws reddish brown; all tibiae with a single delicate yellow spur; wings with brownish clouds, one on each of the three vein forks, a longer one covering the cross veins; an irregular one covers the bases of the veins and a cloud following the length of the cubitus. All veins with scales except the true cross veins and the first anal; venation as in figures. Halteres yellow with brown margins on knob. Length 10mm.

Larva. The empty larval skin from which the figures on plate 41 were made is in a very good state of preservation excepting for a longitudinal break on the dorsal surface of the head and thorax, and the distorted condition of the skin of the thorax and abdomen. In figure 1 [pl.41] the thorax and abdomen are somewhat diagrammatic and the proportions may not be exact owing to the above mentioned fact; the head and the anal appendages however are drawn to scale. The larva resembles Corethra and Mochlonyx (a European genus) in the form of the antennae, which are elongate, and provided with stout spines, set at an angle with the long axis of the antennae [fig.1, 2]. The spines are three in number, wherein this genus differs from Corethra and Mochlonyx which have four. The mandibles are more highly developed than in the other genera of this family, and possess two stout curved teeth, besides several smaller teeth and spines (ventral view figure 3m; dorsal view figure 5). The fanlike brush of hairs so conspicuous in Anopheles, Culex, etc. and somewhat also in Corethra and Mochlonyx seems to be wanting entirely here. The labrum [fig.6] is trapezoidal in shape, its anterior margin being straight. On its upper surface it is provided with two stout bristles, besides 10 smaller ones arranged as shown in the figure. Two converging rows of scales are present, these reaching the extreme front margin. One of these scales is shown in figure 9. The anterior margin is somewhat ciliated; and on the under surface are two converging rows of transverse chitinous ridges, five or six ridges to each row. The maxillae [fig.3*x*] resembles those of Corethra, its anterior margin provided with numerous scales and hairs. The scales resemble those of the labrum [fig.9]. At the base near the articulation of the mandible is a wartlike prominence with four short spines; this may possibly be the maxillary palpus. Toward the inner margin is a single stout bristle. The epipharynx and hypopharynx are wanting in this specimen, probably torn away when the larval skin was shed. The labium [fig.3*l*] is somewhat triangular in shape, its lateral and

anterior margins serrate, six teeth being present in the lateral and 10 in the anterior row. The shape of the head resembles that of Mochlonyx, but with the mandibles more prominent; it is reddish brown in color and heavily chitinized. No eye spots are visible in the specimen.

The thorax is provided with about eight tufts of feathered hairs on each side, the abdomen with about seven pairs. It is possible that several of the more caudad of what is here termed thoracic tufts may belong to the first few abdominal segments. The anal segment and appendages resemble those of Anopheles. The dorsal breathing apparatus [fig.1, 4] shown somewhat flexed sidewise in figure 1, is star-shaped with four radiating pointed lobes, between the anterior pair of which open the two spiracles [fig.4*s*]. At the apex of each of the posterior pair is a single stout bristle. Between the spiracles is a pair of crescent-shaped chitinized brown patches, laterad of which is a pair of small bristles, and another pair is cephalad. The anal segment is ellipsoidal with a row of 31 tufts of hairs, each tuft composed of several hairs; at the caudal end are four (or six) very small blood gills, besides a single large tuft of hairs.

Pupa [fig.8]. This resembles that of Culex and Anopheles. The coloring is like that described for the adult. The breathing trumpets are somewhat less flaring at the top than Anopheles, but more so than is usual with Culex. On the posterior margin of the first segment of the abdomen are three feathered hairs on each side; 2, 3, 4, and 5 each have two feathered hairs on each side plus some scattered hairs; 6, 7 and 8 each have three or four simple hairs on each side. The swimming paddles [fig.7] have a single median rib ending in a short, stout spine.

The venation of the adult wing clearly locates this genus with the Culicidae; the form of the proboscis proves its relationship with Corethra and Mochlonyx, forming with these the subfamily Corethrinae.

Subfamily CULICINAE

This subfamily is characterized by the possession of the typical long proboscis, which is longer than the head and thorax taken together.

Genus ANOPHELES Meigen

Pl. 42, fig. 1–7, 9–11

Moderate sized species resembling the ordinary mosquito. Head rounded, occiput prominent; proboscis bristlelike and projecting forward, longer than the antennae; the palpi in both sexes as long as the proboscis, four jointed, the two end joints

taken together shorter than the one preceding, in the male long haired; antennae 15 jointed, the basal joint disklike, the following ones small, in the male long haired, in the female short and sparsely haired; eyes somewhat reniform, the ocelli wanting; the mesothorax rather long and somewhat pointed in front, and without transverse suture; scutellum narrow, the metathorax rather prominent; abdomen long and slender, eight jointed, the genitalia small and inconspicuous; legs long and slender, nearly bare; wings with the veins and the margin thickly haired, the venation as in the figure.

The females may be easily distinguished from Culex by the presence of palpi about as long as the proboscis; the male may be distinguished by the following characters. In Anopheles the last two palpal joints are much thicker than the first and second, and spatulate in form, while in Culex they are the same in diameter, the last one more or less pointed; further, in all the species which I have examined, a stump of a vein extends back into the basal cell from the base of the radial sector and another from base of R_4+_5; this venation seems to be rare in Culex; in our species also the fourth tarsal joint of the fore leg in Anopheles is more than twice as long as wide, while in Culex it is no longer than wide.

Anopheles punctipennis Say

Acad. Nat. Sci. Phila. Jour. 1823. v.3 and Compl. Wr. 2:39.1

Male. Brown, covered with cinereous hair; head, antennae including the long hairs, palpi and proboscis uniform brown; thorax dark brown with three longitudinal cinereous stripes, the middle one divided by a fine brown line covered with sparse yellow hairs; pleura and scutellum, cinereous brown; metanotum and abdomen dark brown, the latter with the basal two thirds and the extreme posterior edge of each segment with a cinereous bloom, and covered with brown erect hairs; genitalia of moderate size, consisting of two, two jointed appendages, the joints of about equal length, the second one slender, curved and pointed. On the ventral aspect is a sharp caudad projecting spur [fig.10]. Legs uniformly brown except the knees and the extreme tips of the tibiae, which are yellow. The fore tarsal claws have each a long toothed claw and a very short simple one. The feet of the middle and hind legs each have two simple

claws. Wings with brown scales, a quadrangular patch of yellow scales just proximad of the fork of R_2 and R_3 covering a short section of both R_1 and the costal vein; an oblique patch at tip of R_1, crossing the media, leaving the tips black of all excepting R_1; a few scattered pale yellow patches of scales elsewhere; and the posterior margin brown scaled, with patches of white ones at the tip of Cu_2. Halteres pale yellow at base, the knob infuscated. Length $3\frac{1}{2}$ to 5 mm, exclusive of antennae and wings.

Female. Brown, as with the male; abdomen more uniformly brown, covered with nearly erect, fine, yellow hairs; scutellum and metathorax with a fine dark line; tarsal claws all simple; wings as with the male but wider in proportion to the length; venation as in figure 5; the basal section of R_{4+5} distad of the R-M cross vein, as the male. Everything else as in the male. Length 4 to 6 mm.

Larva. Three regions may be distinguished in the larva, viz the head, thorax and abdomen. The head is rounded, brown in color, and completely chitinized; the eyes are situated laterally and seem to be of two kinds; one is compact and more or less circular in outline, the other, visible only in older larvae, is a crescentlike body compounded of ommatidia-primordia of adult eyes. On a level with the eyes and cephalad of them are the antennae, and a trifle caudad of the base of these on the dorsal surface, arranged in a transverse row, are six feathered hairs. These are not placed on a band of pigment as is said to be the case with maculipennis. Between the base of the antennae and the base of the maxillary palpi, on a chitinized prominence, is a conspicuous branched hair. Near the tip on the dorsal surface of the labrum are two simple hairs projecting forward; these are more caudad than in maculipennis. Back of the transverse row of feathered hairs is another transverse row composed of four small feathered hairs; between the latter are usually nine more or less distinct pigment spots, the largest in the center, the others arranged around it. At the extreme cephalic end, at each side of the labrum, is a dense brush of brown hairs; another smaller brush is at the tip of the labrum and on the ventral surface of the labrum are several tiny tufts of hairs just in front of the mouth opening. The piece which carries the tufts on the sides of the labrum is called the scutum of the second metamere or clypeus. The antennae are two jointed, the first short and apparently immovable; the second elongate, free, bearing two rather long spines and two short ones, and a six branched hair, (Nuttall shows four in maculipennis). About one third of its length from the

base is a branched hair. The mandibles forming the sides of the mouth opening; each possess two stout, elongate, and four or five shorter black teeth at the apex, a little below which is a ridge with a serrated edge (not shown by Nuttall). Overhanging the teeth are three scythe-shaped rays, and between their bases and the base of the teeth are a number of brown hairs and one or more curved spines with a serrated inner edge. Projecting inward from about the middle of the mandible is a fan of hairs, and usually also several branched hairs are to be found on the outer margin.

The maxillae (first pair) each consist of a quadrangular piece with curved hairs on the cephalic, and straight ones on the inner margin. On the inner cephalic angle are several stout setae; the palpus is a conical process covered with short hairs, with three elongate spines at the tip connected by a web, and several shorter bristles. Laterally, near the tip, is a hair having four branches, each branch with several twigs. The maxillae together with the labium (underlip of Meinert) form the floor of the mouth cavity. The labium is a chitinized piece with seven to nine teeth on the cephalic margin, forming a continuation of the ventral wall of the head, to which it is articulated [pl.42, fig.3]. A small toothed piece, in outline resembling the labium but with fewer teeth, lying just inside of the latter, is what I take to be the hypopharynx (not shown in figure). Meinert in his work on Myggelarver [pl.41, fig.24], shows both of these, the one slightly displaced in dissection. The thorax is rounded, its segments obliterated. Twelve long feathered hairs stand on the dorsal surface besides some smaller ones and several simple hairs [pl.42, fig.2]. The nine segmented abdomen is provided with a number of feathered hairs besides many bristles. The first two segments each have two long feathered hairs on each side, the third has one (in all specimens examined); the fourth and fifth on each side, each with three or four simple hairs united at the base, the sixth, seventh and eighth, with but one or two, besides these there are two or three short feathered hairs, and several short, simple ones on each side of each segment. The only difference which I have observed in the hairy armature of the abdomen of this species and m a c u l i p e n n i s [figured by Nuttall, *Journal of Hygiene*, v.1, pl.2, fig.4] is the presence of one or two more of the long, simple hairs on the sides of segments 4 and 5. The "palmate hairs" on the sides of 3 to 7 mentioned by Nuttall are also present in this species [pl.42, fig.4*a*]. On the posterior half of the dorsal surface of the eighth segment is the complex respiratory apparatus which surrounds the two stigmata [pl.42, fig.1]. In front of the two stigmata is a brown,

apparently chitinized plate, which may be folded over them, flaplike; on each side of them is a conical papilla with a few bristles at the apex. These are not figured by Nuttall though figured by Meinert for C. maculipennis. Prolonged backward are two lobes (somewhat pressed apart in the figure), and between these is an elongate, flattened, checkered plate forming the floor of the area. On the ventral surface of each posterior lobe are a branched hair and a few bristles. On either side of this structure is a comb, its teeth projecting caudad. Each comb has about seven long teeth, and between each of these are from one to four shorter ones. The cylindric ninth segment, when the animal lies horizontal, its dorsal surface uppermost, is suspended obliquely below the breathing apparatus, its dorsal surface covered with a chitinized plate or saddle. From its ventral surface, attached to a keellike process, is a fanlike arrangement consisting of two rows, each with nine branched hairs. On the dorsal surface are four hairs, the two anterior ones are feathered, the two posterior (and also a little more lateral) are branched. The anus is at the extremity of the segment, and surrounded by the four white papillae or blood gills.

Pupa. Resembles that of the other Culicidae. "When viewed sidewise, the pupa of Anopheles presents a comparatively smooth outline, but in Culex the edge where each tergum joins posteriorly the soft integument which unites it with the succeeding tergum stands out as a ridge, and the dorsal outline presents a series of salient angles" [Nuttall & Shipley]. "Respiratory trumpets are not so broad terminally in Culex as in Anopheles" [Howard]. [pl.42, fig.11]

Anopheles maculipennis Meigen

1818 A. maculipennis Meigen, Syst. Beschr. 1:11 Compl. Wr. 1:241
1823 A. quadrimaculatus Say, Long's Exp. Apx. p.356.
1828 A. quadrimaculatus Say, Wiedemann, Aussereur. Zweiflüg. 1:13

Female. Brown. Wings with four fuscous spots. Head, antennae, proboscis and palpi pale brown. Thorax dull cinereous brown, covered with sparse yellow hairs; with two brown lines nearly contiguous posteriorly; pleura cinereous; scutellum and metanotum brown, the latter bare. Abdomen brown, rather thickly covered with suberect yellow hairs, ventral surface paler. Legs brown, the femora pale, knees and tips of tibiae pale yellow. Wings hyaline, the veins with pale brown scales, a spot of darker scales at the base of the radial sector, one at the fork of R_1 and R_2, one at the fork of the media, and a

fourth at the cross veins. Venation as in figure 9. The basal section of R_{4+5} proximad of the R–M cross vein. Halteres pale, with a fuscous knob. Nuttall and Shipley state and also show in the figure which they give of the wing of maculipennis that the subcosta extends almost to the tip of the wing. In all specimens of females which I have examined this is not the case with the American form. Should this difference be found constant, Say's name of quadrimaculatus must be restored.

Larva. According to the description and figure given by Nuttall and Shipley [1901], it differs from that of punctipennis in the following particulars. The six feathered hairs arranged on the dorsal surface of the head are placed on a transverse band of pigment. On the dorsal surface of the labrum are two simple hairs projecting forward; these are more cephalad than in punctipennis. The pigment spots arranged symmetrically about the median line, so conspicuous in punctipennis, are wanting in this species. At the end of the second antennal joint is a four branched hair according to the figure given by Nuttall, whereas this hair has six branches in punctipennis. The mandibles show some differences. The only differences in the hairy armature of the abdomen which I have observed in punctipennis, in comparing with the description and figure of Nuttall of maculipennis, is the presence of one or two more of the long, simple hairs of segments 4 and 5 in the former species.

Pupa. Agrees in all particulars with the description given for punctipennis. A comparison of fresh specimens of both species will be necessary to reveal differences.

Genus PSOROPHORA Desvoidy

Large species which resemble Culex in having a straight proboscis; the male has palpi as long as the proboscis, those of the female being short. It differs from Culex in having many nearly erect scales on the legs.

Two species have been described from the United States. They may be distinguished by the characters given in the key below.

Length 6mm exclusive of the probocis; cell 2d R much longer than the cell M; body black, the humeri yellow, pleura and sides of the mesonotum bearing many appressed white scales, abdomen on the upper side covered with appressed violet purple scales, those on the first segment and a few at the hind angles of some of the other segments white. (Hartsville S. C.) Canadian Ent., 1901, p.258.....howardii Coquillett

Length 9 or 10 mm; cell 2d R only a little longer than M [pl.42, fig.8]. Thorax striped; body brown; legs yellow, with dark brown or black erect scales. United States, widely distributed. Wiedemann, Aussereur. Zweiflüg. 1828. 1:13....
ciliata Fabricius

The life history of P. ciliata is given by Howard in the *Canadian Entomologist* for 1900 and also in his work on mosquitos. Of the larva he says, "from Culex it differs in having a longer breathing tube, longer and more pointed blood gills, and the hair fringe on the under side of the anal segment much longer and denser. The jaws are sharply toothed and very long." From the figure it appears also that the mouth brushes project laterally and not forward as in Culex. Figures are given in both of the papers of Howard, mentioned above.

Genus CULEX Linne

The species of this genus are the ordinary mosquitos. In most respects they are like the species of the genus Anopheles, but differ from them in that the male alone possesses the elongate palpi, in the female these are very short; the mesothorax is more arched and more nearly vertical in front; and the hypopygium of the male is quite conspicuous, whereas with Anopheles it is small and inconspicuous. In other respects, including the biting habits of the female, just like Anopheles.

It may be added, that in all species of Culex examined it was found that the fourth tarsal joint of the fore leg in the male is only about as long as it is broad; and that the last joint of the palpus is pointed. The wing venation also appears to present differences from Anopheles, in that the spur at the base of R_{4+5} is usually wanting in Culex.

Larva. The larvae are usually known as wrigglers, and characterized by their rapid wriggling movements, their wormlike bodies and disproportionately large heads with a pair of prominent eyes, an enlarged thorax, and their possessing on the dorsal surface of the eighth segment an elongate breathing tube. The eggs of some species are laid on the surface of the pond or pool in an oblong mass or boat, which in the warmer spring or summer weather hatches within a day or less. The small transparent larvae are extremely active from birth. They come to the surface to breathe, the elongate breathing tube of the last segment being in contact with the surface film, the cephalic end hanging obliquely downward. When disturbed the larva descends to the

bottom, jerking its body rapidly from one side to the other. It appears to be heavier than water, for sometimes it may be seen to descend quietly, apparently without motion; though, in order to rise, it "wriggles" to the surface. In the full grown larva the head, more or less rounded, is large, usually nearly as wide as the thorax from which it is separated by a narrow neck. The antenna, which arises from a slight prominence a little in front of the eye, consists of a single elongate shaft, with a short terminal joint (which appears to be annulated), several bristles and jointed hairs at the end of the first joint, and a tuft of hairs at about the middle of the shaft. Projecting from the middle of the anterior end of the head is a complex arrangement of hairs which spring from two folded ridges one on each side of the ventral surface of the labrum [pl.43, fig.5]. The length of the hairs varies with the species. Meinert [*De Eucephale Myggelarver*] speaks of this as a whorl, or rotatory organ, as he believes that it is by the vibrations of these bristles that the food is directed into the mouth. The greater part of the upper surface of the head is formed of a single plate which Meinert [*loc. cit.*] calls the dorsal surface of the third metamere. In front of this is a short, broad plate ("scutum of the second metamere," Meinert), called the clypeus by Giles [*Mosquitoes*]. [pl.44, fig.8*c*]

Attached to the anterior margin of the latter is the round prominence covered with hairs; this is the labium [pl.44, fig.8] or "scutum of the first metamere" [Meinert]. If the front part of the dorsal surface of the head be removed and turned ventral surface uppermost [pl.43, fig.5], the two fans or rotatory organs [fig.5*f*] may be seen, mesad and caudad of which are two tufts of hair projecting caudad. Between the latter is a rounded process on which are from two to four spines. This process together with the two tufts of hair, I believe to be the epipharynx[*e*].

The eyes are large and placed laterally, behind which and lying close to, may usually be seen a small ocellus. On each side of the mouth opening, ventrad of the fans, are the mandibles; stout, quadrangular pieces with a number of sharp teeth, at the cephalic end with two stout spines curved mesad, a row of hairs arranged on a ridge or keel overhanging the teeth and another row of long hairs arranged on the posterior margin [pl.45, fig.1, 2]. A fingerlike process with hair at its apex projects mesad from the mesocaudal margin [fig. 2*a*]. Ventrad of the mandibles are the maxillae [pl.43, fig.4*x*]. These are also indicated by dotted lines under the mandibles [*m*] on right hand side, the figure being a dorsal view of the lower half of the head,

the dorsal surface having been removed. The maxillae are fleshy ovoid processes with a longitudinal row or terminal tuft of hairs, besides the long, loose hairs on the mesal surface. Attached to the base and projecting laterad is the palpus with its four or five terminal spurs or papillae. Forming the floor of the mouth cavity, and attached to the anterior edge or coalescent with the sclerite which forms the lower surface of the head is the labium [pl.43, fig.4*l*]; a more or less triangular or semicircular piece with a toothed margin. The ventral surface and margin is usually fringed with setae.

The hypopharnyx is a toothed piece resembling the lower jawbone of a mammal, and lies tonguelike on the floor of the mouth cavity [pl. 43, fig.4*h* and pl.44, fig.6]. It is quite small and, being loosely attached, is easily torn away in dissection, hence somewhat difficult to find. Attached to the posterior edge of the hypopharynx [pl.44, fig.5], and lying obliquely, with reference to the frontal plane, but perpendicular to the sagittal plane, is an elliptic flat ring. This ring is compound, made up of four lamellae in close contact, so that it appears at first sight as a single ring; the surface of the lamellae is striated and fringed on the inner margin with long cilia. A portion of the front end of this ring is shown on plate 44, figure 5*s*. It appears to be the anterior margin of the gullet, and may perhaps act as a kind of sieve on which the food particles swept in by the rotatory fans, are caught. A second toothed piece [pl.44, fig.5*t*] lies dorsad of the anterior lobe of the hypopharynx, and is probably a part of it.

The thorax is circular in outline, and wider than the head. In the full grown larva the sutures separating the three thoracic segments can not be distinguished. On its surface are tufts of long bristles, longer usually than those on the rest of the body. These bristles are feathered, though not so much so as in Anopheles. The hairs appear to act as balancers. In addition to these hairs are a number of smaller, shorter tufts.

The abdomen is five or six times as long as the thorax, but of much smaller diameter; consisting of nine segments counting the anal segment. The segments are subequal in length excepting the first, eighth and ninth, which are frequently shorter. On the lateral margins are tufts of a few long hairs besides a few shorter ones, the arrangement of which may give specific characters, though, owing to the ease with which they fall off in alcoholic specimens, they must be used as distinctive characters with some caution. Projecting from the dorsal surface, near the posterior margin of the eighth segment, is a long, more or less cylindric tube, into which the two main respiratory

trunks can easily be followed, and are seen to open at its extremity. On each side of this tube is a single row of short spines, and at the base is a tuft of short hairs. On each side of the eighth segment is a comb composed of a variable number of short spines [pl.45, fig.6]; the tip of each spine is sometimes covered with short hairs.

The ninth abdominal segment, usually shorter than the others and of less diameter, contains the rectum and the anus, being almost at the extremity of the body. Around the opening are two pairs of delicate, elongate lobes. These are tracheal or blood gills. Immediately cephalad of these are dense tufts of long hairs, the position and arrangement of which are variable with the species. Usually also, dorsad of the blood gills are a variable number of long bristles.

Pupa. The pupa differs from those of the other genera of this family less than does the larva. It is characterized by its bulky, oval, laterally compressed anterior part, made up of the head, thorax and its appendages, and a posterior part, consisting of the abdomen with its swimming paddles [pl.43, fig.7]. The length of pupal life in all observed specimens was about four days. During this time the pupa would remain quietly floating with its thorax nearly vertical, its abdomen bent under, unless disturbed, when it propels itself to the bottom by means of the violent contractions of the abdomen, after the fashion of a crawfish. The specific gravity apparently being less than water, however, it requires a constant effort to remain at the bottom.

The head is bent down under the thorax, the antennae folded back arcuate and lying along its sides; the legs folded up in a sinuate fashion; the wings extending downward and backward from the sides. Near the highest point of the thorax, the pupa occupying its usual vertical position [pl.43, fig.7], are the two breathing trumpets, elongate, subcylindrical tubes, open and somewhat flaring at the top [pl.44, fig.11]. On the dorsal surface near the posterior margin of the thorax, are usually a pair of stellate hairs. The abdomen has eight segments, subequal in length except the first and last two, which are shorter, and on the posterior margins of which are a few tufts of branched hairs. Attached to the last segment is a pair of broad swimming paddles, each reinforced by a stout longitudinal rib, and ending in a single short spine. Between the paddles is a furcate fleshy process in which are contained the genitalia of the inclosed imago. The shape of this fleshy process differs with the sexes, and perhaps also with the species. The pupae of all the species I have examined resemble one another so closely that I have been unable to distinguish them. It appears however that there

are slight constant differences in the form of the air trumpet and in the number and arrangement of the abdominal hairs. Fresh specimens should however be examined in order to characterize them correctly.

The arrangement of the bristles on the abdomen is about the same in all the species examined. On the dorsal surface of the first abdominal segment are a pair of conspicuous stellate hairs, the remaining segments each have about three pairs of lateral discal hairs, and two pairs of small, branched, marginal ones; one of the marginal pairs of the eighth segment being many branched. Besides these there are usually a few scattered hairs.

Much has been written about the species of this genus, but the fact that most of the older descriptions are inadequate renders the synonymy much involved. Coquillett has done the best and most recent work on the North American species; and the reader is referred to his papers published by the United States Department of Agriculture, or, better still, to his table given in Howard's book on mosquitos, for the determination of the adults. In the last mentioned work will be found a most complete description of the life history of several species of mosquitos. The recent work of Theobald is a monograph of the Culicidae of the world.

Dr Dyar has recently published in the Proceedings of the Washington Entomological Society (1902 and 1903) and in the Journal of the New York Entomological Society (1902 and 1903) the descriptions of the larvae of a number of species of Culex, together with keys for their identification. The following key is adapted from one given by him, modified to include species more recently described.

KEY TO SPECIES OF CULEX LARVAE

1 Without a longitudinal row of spines on the air tube; hair tufts of anal segment confined to the barred area; seventh segment with a round dorsal plate incised anteriorly..... signifer Coq.

With a longitudinal row of spines or hair on the air tube.....(2)

2 Air tube at least four times as long as its breadth at the base .....(3)

Air tube less than three times as long as broad.....(9)

3 Antennae with hair tuft beyond the middle of the joint.....(4)

The antennal tuft at or before the middle.....(8)

4 Air tube six or more times as long as broad; antennae white banded .....(5)

Air tube 4 or 5 times as long as broad.....(6)
5 Tube concave, the tip wider than the terminal portion. Spines of tube mostly with a single basal branch.....territans
Tube regularly tapered, smallest at the tip. Spines of the tube 3 to 4 branched.....nigritulus
6 Anal segment without hair tufts anteriorly of the transversely barred area.....(7)
Anal segment with hair tufts on the ventral line up to the base.....dyari
7 Lateral comb of the eighth segment a patch of spines; tube brown.....pipiens
Lateral comb a row of bars; air tube black.....melanurus
8 Apex of the labium rounded [pl.44, fig.1]. Antennae whitish on basal half.....restuans
Apex of labium pointed [pl.45].....cantans
9 Lateral comb of the eighth segment a patch of small spines three or more rows deep.....(10)
Lateral comb a few spines on a single or partly double row.....(13)
10 Anal segment with hair tufts before the barred area.....(11)
Anal segment without tufts before the barred area.....(12)
11 The spines of the air tube prolonged into setae; tube about three times as long as wide; the antennal tuft is at the middle of the joint.....consobrinus
The air tube with spines, anal segment broadly plated..canadensis
12 Antenna with a small tuft a little before middle of the joint. Air tube about two and a half times as long as wide; lateral comb about three rows deep.....bimaculatus
Antenna with a single inconspicuous hair instead of a tuft. Air tube not over twice as long as wide; lateral comb about five rows deep.....atropalpus
13 Anal segment with hair tufts before barred area.....(14)
Anal segment without tufts before barred area.....(16)
14 Comb of eighth segment of separate nearly simple spines, the spines of the air tube each with three teeth.....sylvestris
Comb of eighth segment either toothed or digitate.....(15)
15 Comb of eight segment composed of spines with finely digitately divided tips; antenna with a single long seta instead of a tuft.....triseriatus
Comb of conspicuously toothed spines, joined on a weak basal plate. Antenna with a small hair tuft.....jamaicensis
16 Comb of eighth segment of nearly simple, thorn-shaped teeth.....sollicitans
Comb of eighth segment of pectinated spines in an incomplete double row.....taeniorhynchus

The pupae resemble each other so closely that I have been unable as yet to find satisfactory characters to distinguish them.

Culex restuans Theobald

Plate 44

Monogr. of Culicidae, II:142

Male. Length 4.5 to 5 mm. Uniformly fuscous. Palpi as in plate 44, figure 12. The thorax is apparently marked with stripes; bases of the abdominal segments with yellow scales; bases of the femora and the tips of the tibiae yellow. Tarsal claws of the fore and middle legs unequal, each with a tooth, hind claws simple. Male genitalia resemble those shown on plate 43, figure 11; but the apex of the terminal claw is sinuous, and with a tiny hooked appendage. Wings hyaline, with fuscous scales. Venation as in figure 9. Halteres pale.

Female. Palpi as shown in figure 13. All tarsal claws simple. Venation of the wing as in figure 10. In other respects like the male.

Described from alcoholic specimens obtained from Professor Needham. Bred. Saranac Inn N. Y., July 21, 1900.

Larva. Length 7 to 8mm. The head is round, widest at the eyes, slightly wider than long, with six moderately long hair tufts in a transverse row immediately back of the antennae; the antennae slender, uniform, and brown in color but paler at the base. On the shaft is a tuft of 10 to 12 long hairs, a little below the middle, and at the tip are three slender and one stout spine and the stout apical joint. Rotatory fans normal. The mandibles have immediately above the teeth a long, stout spine with a serrated inner margin. The maxillae possess a pair of moderately long dorsal spines. The cephalic margin of the labium is arcuate, with about 23 teeth, besides three on each lateral margin [pl.44, fig.1]. The epipharynx is of the usual shape, though its lateral spines are somewhat longer than the median [fig.6]. The hypopharynx has a toothed margin and eight spines, four on each side, two lateral lobed processes each with six fingerlike projections and a median piece with a lobed margin [fig.5]. The labrum [fig.8] is hairy as usual, the clypeus [fig.8c] with two stout spines on its dorsal surface. On the gula are two trifid hairs. The thorax is rounded, and at the base of the larger tufts of hair are spurlike processes with four or five teeth projecting cephalad. The long, loosely feathered hair tufts of the thorax consist of the usual anterior transverse row, and the two lateral groups [fig.3]. The hairs of the abdomen are arranged in tufts of about equal length, though there are fewer hairs in the posterior ones; air tube brown, of moderate length, the row of lateral spines on it each with from 15 to 20 spines; caudad of which are a few long hairs. The lateral combs of the eighth

abdominal segment with 30 to 32 teeth arranged in about three irregular rows. Caudad of this comb is a tuft of nine feathered hairs, and dorsad and ventrad of it are several small bristles. On the dorsal margin of the ninth segment are three or four long bristles, and on the apical third of the ventral surface is a brush of long hairs consisting of from nine to 12 tufts. In most specimens the blood or tracheal gills are long, extending beyond the tip of the breathing tube.

Pupa. The breathing trumpet [fig.11] is somewhat widened at the top, about five times as long as wide, its apical margin oblique. On the most posterior of the thoracic sclerites are three pairs of short, stout, branched hairs; on the dorsal surface of the first abdominal segment, are the usual pair of stellate hairs; the remaining segments each have about three pairs of lateral discal hairs and two pairs of small branched marginal ones, one of the marginal pairs on the eighth segment being many branched.

Culex pipiens Linnaeus

Plate 43

Male. Length 4mm. Antennal joints grayish white, the tips black, the long hairs brown; proboscis and palpi pale fuscous, the latter darker at the tip with long, dark brown hairs; occiput with yellowish hairs; dorsum of thorax yellowish brown, with five indistinct, darker brown stripes, on each of which is a row of a few black or brown bristles, elsewhere covered with yellow scales; pleura metanotum and scutellum yellowish brown, the last slightly darker, with a few long brownish hairs; abdomen long haired, segments fuscous, at the base rather widely fasciated with yellow scales; ventral surface paler fuscous; genitalia yellowish, not very prominent [fig.11]; legs fuscous, quite pale on the coxae and base of femora, gradually becoming darker distally, the tarsi being quite dark; the knees and extreme tip of tibiae, yellowish. The fore and middle pairs of claws unequal, the longer one inside, each claw with a distinct tooth [fig.8]. The hind claws simple. Wings hyaline, scales fuscous [fig.10]. Halteres pale.

Female. Length 4mm. Antennae, proboscis and palpi uniformly fuscous; abdomen fuscous, with a very narrow basal fascia of yellow scales on each segment; ventral surface paler; femora with basal half and flexor surface yellow, gradually becoming darker distally, tibiae and tarsi as with the male. All tarsal claws simple [fig.9]. Wings with fuscous scales. Venation as in figure 12. All else as with the male. Bred specimens. July 18, Aug. 31, and Sep. 7, 1901. Ithaca N. Y.

Larva. Length 7 to 8 mm. The head is nearly circular in outline, color pale fuscous, with six moderately long tufts of hair on

the dorsal surface, the lateral ones near the base of the antennae, the others more caudad [fig.2]; eyes large; antennae flattened, wider on the portion below the hair tuft, which is composed of 20 to 30 loosely feathered, long hairs on the side at about two thirds its length from the base; its apex with four slender and one stout bristle besides the short apical joint. The rotatory fan [fig.5*f*], labrum [*lr*] and epipharynx [*e*] normal; clypeus with the usual pair of setae; the mandibles with a long, stout, curved, pale brown spine with a serrate inner margin, projecting beyond the black teeth. A pair of small spines are found on the dorsal surface of the maxillae, and a small seta near the apex [fig.4*x*]. The cephalic margin of the labium [fig.4*l*] is elliptic, the median tooth longer than the others, and the hypopharynx [*h*] is of the usual shape [pl.44, fig.5]. The thorax is rounded; arranged on the dorsal surface in a transverse row near the cephalic margin are 10 or 12 equally spaced tufts of long hairs, the median tuft largest. A little caudad of the middle line, near the lateral margin are six or eight long hairs in an irregular transverse row, and on the lateral posterior margin, are two tufts of five or six short hairs each. The outline of the abdomen presents a sinuous margin, the segments being somewhat constricted at the incisures. On the prominence of each side of the segments are three or four moderately long hairs. The lateral combs of the eighth segment consist of a patch of about 50 spines. Caudad of the lateral comb is a tuft of about eight feathered hairs, and dorsad and ventrad of this is another smaller tuft. The ninth segment has five or six long setae on the dorsocaudal margin, 13 or 14 branched hairs of about six branches each on the caudal third of the ventral surface and four rather long sharply pointed blood or tracheal gills. The breathing tube is rather long, with from 10 to 15 serrate spines in a longitudinal row on each side, and on the ventral surface are three pairs of long and several short tufts of hair.

Pupa [fig.6, 7]. The breathing trumpet is comparatively long, widest at the apical third, its opening extending downward on one side to almost the middle. On the abdomen are the usual bristles, those on the lateral margin being larger toward the caudal end. Swimming paddles are of the usual shape.

Culex cantans Meigen

Plate 45

Syst. Beschr. 1818. 1:6, 2:6

1848 C. stimulans Walker. List etc. Synonymy according to Coquillett.

Male. Length 7 or 8 mm. Antennae with long fuscous hair; proboscis and palpi yellowish brown, the latter

with a band of dark scales near the base; joints dark; occiput with yellowish white scales; thorax with a black or brown ground, thickly covered with short golden yellow hairs, with five narrow longitudinal stripes of white scales. The lateral stripes are not parallel with the intermediate pair, but, starting anteriorly quite close together, diverge rapidly and end near the base of the wing. The white stripes are frequently quite indistinct, in which case the thorax might be described as having two rather wide yellowish stripes; pleura and scutellum with whitish hairs; metanotum brown and bare; each segment of the abdomen dorsally with its anterior third covered with short, whitish scales, which extend also in a narrow more or less broken line along the lateral margin. Posterior part of the segments is black with an occasional paler scale, particularly on the posterior margin. The last segment is nearly covered with white scales. Venter with yellowish white scales, which are rather thickly interspersed with long, pale brownish hairs; hypopygium prominent, black; flexor surface of the femora white, extensor surface sprinkled with brown; flexor surface of the tibiae and metatarsi yellow, extensor surface brown; tarsi black with the basal third or fourth white. Claws all with a tooth on the underside of each. One claw of the middle foot is much longer than the other and is sinuous in outline [fig.10]. Wings hyaline with blackish scales and a sprinkling of paler ones. Fourth tarsal joint of the male short. Venation as in figure 9. Halteres white.

Female. Antennae pale brown; proboscis fuscous; venter of abdomen without long hairs; genitalia black; anterior femora and tibiae brownish, with scattered whitish hairs; fore and middle tarsal claws with a single tooth, hind pair simple. In all other respects like the male.

Larva. Length 11 to 12 mm to the tip of the breathing tube. The head is dark brown, antennae with two slender and two stout apical setae and a short terminal joint; at a little below the middle is a tuft of about eight hairs, and on the shaft are a number of short, thick spines. The color of the antennae is a uniform dark brown. The rotatory fans are rather long, the individual hairs are noticeably pectinate at the tip. The mandibles, maxillae and labrum are normal, the latter apparently without the pair of dorsal spines, possessing a long, thick tuft of hair apically and a comparatively large palpus. At the base of the palpus on the triangular sclerite is a stout spine, and caudad and mesad of this is another, placed close to the suture which separates the lateral from the ventral sclerites of the head. The labium resembles that of C. triseriatus but

is somewhat more rounded, the middle tooth prominent. The thorax is transversely oval, with three or four rather short, stout setae on the cephalolateral margins, caudad of which and near the lateral margin is a tuft of short hairs; on the middle of the lateral margins are two tufts of feathered hairs, and caudad of this is another pair. The abdominal segments are slightly constricted at the incisures; the first segment has three or four long feathered hairs on each side; the rest of the segments each have about two on each side, besides some short, scattered ones. The lateral combs of the eighth segment have 35 or 40 teeth each. The ninth segment has a tuft of about 16 dorsocaudal bristles, one of them longer than the rest, and on its ventral surface are about 16 tufts, the first four somewhat separated from the rest and from each other. The dorsal surface of the segment is covered by a brown chitinized saddle. The tracheal or blood gills are of moderate length. The breathing tube is long, about four or five times as long as wide; with 20 or 25 lateral serrate spines in the longitudinal row, the basal four or five being smaller than the rest.

Pupa. The pupa greatly resembles those of the other species. The breathing trumpet widens at about one third the distance from the base, its open end only slightly oblique.

Described from a number of bred specimens. May 1901. Ithaca N. Y.

Culex sylvestris Theobald

Monogr. Culicidae. 1:406

This species will fall in the same couplet with C. stimulans Walker (=C. cantans Meigen), in the key given in Dr Howard's book on mosquitos (1901 ed.). It is apparently not uncommon and has probably heretofore been confused with the above mentioned species. It greatly resembles C. cantans, it also agrees fairly well with the descriptions of C. vexans Meigen and with Walker's description of C. stimulans. From the first it differs in having (in *unrubbed*, bred specimens) an unmarked thorax, and in having only the immediate bases of the tarsal joints white. The male also has the long claw of the middle foot slightly curved but not sinuous [*compare* pl.45, fig.10 and pl.40, fig.11]. From C. stimulans it differs in having the posterior fork cell wider and shorter than the anterior, while in stimulans, according to Giles, they are "of about equal length and breadth." From both

of the foregoing and from C. vexans also, the male differs in having a white band on the middle of the long second joint of the palpus. In spite of the tooth on the underside of the hind claws I believe my identification is correct.

Male. Length 5mm. Antennae with long fulvous hairs, proboscis and palpi dark brown, the latter with a white band on the middle of the long second joint, and the bases of the third and fourth joints white. The occiput with golden yellow hairs and patches of blackish and whitish scales; dorsum of the thorax with a black or brown ground uniformly covered with golden yellow hairs, the posterior margin and the scutellum with a fringe of longer yellow hairs; metanotum light grayish brown, bare; pleura brown with whitish scales.

Each segment of the abdomen dorsally with its anterior fourth covered with short white scales; posterior part of the segments black slightly produced forward in the center and the posterior margins of the next to the last whitish; the last one wholly black; genitalia brown, the apical joint slender with a spine near its apex [pl.40, fig.12]; venter pale brown with whitish scales; entire abdomen with long, erect pale brown hairs; femora brownish, the bases and the flexor surface of the middle and hind pairs and sometimes the front pair also, white; tibiae and tarsi brownish black, flexor surface paler; the immediate base (about one eighth of the length) of each joint of the tarsi yellowish white. The hind legs with erect, yellow setae. All tarsal claws with a tooth on the under side of each. The long claw of the middle foot as shown in figure 12. The venation is about as that shown for C. cantans, though the posterior cross vein is not oblique. Halteres yellowish white.

Female. Differs from the male only as follows. Antennae brown, basal two or three joints yellow; abdomen marked like the male, but the long hairs are only on the posterior margin of each segment; genitalia black, consisting of two fingerlike lobes; venter yellow with white scales, posterior margin of the segments black. Tarsal claws like the male.

Described from bred specimens.

Larva. The larva resembles that of C. cantans. The mandibles are like those shown on plate 45, though the teeth are more blunt; the maxilla is like that shown on the same plate, though the palpus is rather shorter than shown here, and there are two lateral spines. The labium is pointed, and the antenna has a tuft of bristles near the middle. The teeth on the sides of the eighth segment are arranged in one irregular row. The spines of the longitudinal row of the breathing tube each have

two or three short teeth near the base, the two or three elongate distal spines being separate from the others and from each other. Breathing tube about two and one half times longer than wide. The setae of the ninth segment extend forward from the barred area.

Pupa. The plane of the margin of the breathing trumpet makes about a 30° angle with its long axis. Specimens taken July 10, 1902, Ithaca N. Y.

Culex triseriatus Say

Plate 46

Acad. Sci. Phila. Jour. 3:12. 4 Compl. Wr. 2:40; Wiedemann, 1:11, 12

Female. Length 4½mm. Antennae uniformly grayish, the large basal joint yellowish, the joints of the flagellum verticillate, with a few long, black hairs, besides which the shaft is covered with sparse grayish white, downy hair; proboscis fuscous, including its base and the epistome. Palpi one fourth as long as proboscis, cylindric. Occiput covered with silvery white scales; dorsum of thorax with a very broad black stripe, widened posteriorly, where it covers the space to the base of the wing excepting a spot of white scales in the middle line on a line with the bases of the wing; scutellum and metanotum black; the sides of the anterior part of the dorsum, and the pleura, covered with white scales; abdomen covered with deep black scales. The anterior margin of the dorsal surface of the segments are fasciate with dark brown scales, and the anterior margin of all segments on the ventral surface fasciate with white scales. These latter fasciae extend to the sides and their extremities are just visible on the dorsal aspect. The last segment is yellow, genitalia black; the legs black, the coxae, the flexor surface of all the femora, the bases of the first and second pairs, the basal two thirds of the hind pair, and all the knees, white; tarsi sometimes dark brown. The fore and middle pair of tarsal claws each with a tooth, those of the hind pair simple. Wings smoky, the scales black, those on the posterior margin brown. Venation as in figure 7. Halteres white.

Male. Antennae wanting. Like the female in all respects excepting as follows. The black dorsal stripe slightly narrower; the long palpi are black, hypopygium prominent, the front tarsal claws of unequal size, one long and curved, the other shorter and nearly straight; both with a single tooth on the underside, the middle claws each with a tooth, hind ones simple. Described from specimens bred July 1901. Ithaca N. Y.

Larva. Length 7 to 8 mm. Head [fig.3] is round, in color brown; in the transverse row between the bases of the anten-

nae are six tufts of hairs, the median pair short; caudad of these is one pair of long setae, and directly caudad of each eye is a single one. The antennae [fig.1] have three or four apical bristles besides the usual small terminal joint, and a little distad of the middle is a single long seta. Labrum, rotatory fan and maxillae normal, the two dorsal spines of the latter rather longer than in C. pipiens and the papillae on the mesal surface are more prominent. The spines of the epipharynx as in C. pipiens, but the lateral ones shorter than the median pair. The stout apical spine of the mandible [fig.2] does not project beyond the tip of the teeth. The labium [fig.4], is triangular with 19 teeth, hair on its ventral surface, and caudad of the transverse suture are two pairs of setae. The hypopharynx, shown somewhat diagrammatically in figure 6, has a number of sharp teeth besides two lateral lobes with fingerlike processes (not shown in the figure). On the dorsal surface, along the cephalic margin of the thorax, are six or eight hair tufts, all rather short except the lateral ones, which are of moderate length; on the middle and on the posterior end of the lateral margin are two long tufts. Near the caudal margin are two stellate hairs. Each abdominal segment has, besides the long lateral tuft, four short dorsal tufts and a few short lateral and ventral hairs. The lateral comb of the eighth segment is composed of about eight spines arranged in one irregular row; the ninth segment but little longer than wide, is provided with a dorsocaudal tuft of 10 or 12 hairs, a ventral row of about 10 tufts, each tuft with four or five hairs. The blood or tracheal gills are comparatively short. The breathing tube is short, about twice as long as wide, with a lateral longitudinal row of 18 to 20 spines, at the caudal end of which is a single hair tuft.

Pupa. The pupa does not appear to differ from C. cantans. The air trumpet is widened at the top, the plane of the margin of the aperture makes about 45° with the longitudinal axis. Bred specimens. July 1901. Ithaca N. Y.

Genus AEDES Meigen

Small, brownish or blackish gray species closely resembling Culex, differing only in that both sexes have very short palpi. According to Van der Wulp, the palpi, though short as in the female of Culex, are not cylindric as in the latter genus, but conical or pointed, and consist of two joints only. But two species of adults are known from the United States.

A. fuscus O. S., Western Diptera. 1877. p.191. Cambridge Mass.
A. smithii Coquillett, Canadian Ent. 1901. p.260. New Jersey.

Imagines

These two species may be distinguished as follows:

With cross bands of yellowish scales at the bases of the abdominal segments..... A. fuscus O. S.
Without these bands.....A. smithii Coquillett

Larvae

With four anal blood gills..... fuscus
With two anal blood gills..... smithii

Aedes fuscus Osten Sacken

The larva is described by Dr Dyar in the Journal of the New York Entomological Society for 1902, page 197. This larva differs from that of A. smithii in having four long narrowly taper-pointed blood gills instead of but two. The antenna has a tuft of hair a little before the middle; the breathing tube is about three times as long as wide; its spines are single toothed. The ninth segment has tufts before the barred area; the lateral combs of the eighth segment consist of a single irregular row of rather course spines.

"The pupa is normal, its air tube cylindrical, slightly bent but not widened into funnel shape."

Aedes smithii Coquillett

Plate 47, fig. 1-6

The adult is described by Coquillett in the *Canadian Entomologist*, 1901. Of the life history Prof. J. B. Smith has discovered the following:[1]

"The female Aedes lay their eggs in the newest leaves of the pitcher plants (Sarracenia), and do not always wait for water to collect in them. Of the specimens of larvae which he had taken during the winter the last one changed to the pupal state about Sep. 9; thus being in a larval state since the preceding October. He thought that there were about three broods, and that the different specimens vary in their time of appearing, which seems to give one continuous season."

The larva has already been well described by Dr Dyar, in New York Entomological Society Journal, December 1901, page 178, plate 10, figure 1. It greatly resembles the larva of Culex, this species differing from the known members of that

[1]Ent. News. 1901. p.254. *See also* N. Y. Ent. Soc. Jour. March 1902.

genus in the following particulars. The mandible has but one large bristle or curved spine at the apex (in all specimens examined); the papillae of the maxillae are elongate and sharply pointed; and the blood gills at the posterior end are only two in number.

The characters of the species are as follows: Head rounded, somewhat flattened; eyes very small, round, and black; rotatory fan conspicuous; antennae slender, uniformly pale in color, the lateral tuft represented by a single seta, its terminal appendages short, consisting of two or three slender setae, a blunt spine and the usual short terminal joint [pl.47, fig.1]. The mandibles [fig.2*m*] are shaped like those of Culex but appear to have but one stout, curved seta at the apex; the bearded process caudad of the teeth has a stouter base than in Culex; maxillae [fig.2*x*] elongate, pointed papillae and several terminal setae besides the usual long hairs. The labrum resembles that of Culex, the clypeus with a pair of rather elongate blunt spines. Epipharynx as in Culex, though with but two instead of four spines. The labium triangular with a long central tooth and nine teeth on each side of this [fig.2*l*]. The gula is apparently without setae. On the dorsal surface of the head between the bases of the antennae in a transverse row are four small setae, and caudad of each of the two inner ones is another. Thorax quadrate, wider than long, lateral margin sinuous; dorsal hairs short, those of the three lateral groups long; abdomen slender, segments subequal in length, the long lateral hairs about of equal length, those on the anterior segment, four to six in number, diminishing in number caudad, so that on the last two segments there are usually but two on each side. The dorsocaudal and ventrocaudal tufts short and composed of two or three hairs. The lateral combs of the eighth segment consist of 15 to 20 stout teeth arranged in a single somewhat irregular transverse row. The air tubes rather short, about three times as long as its greatest diameter; with four rows, each with five or six long setae [fig.6]. The two longitudinal rows of teeth which are present in Culex are entirely wanting. The anal segment is short, with two inflated translucent blood gills and with dorsocaudal, laterocaudal and ventrocaudal tufts of long hairs; the ventral brush wanting.

The pupa has the posterior margin of the swimming paddles ciliate with short hairs instead of terminating with a single bristle as it does in Culex. Near the anterior margin of the thorax is a pair of long setae, caudad of which are two pairs of short forked hairs. The breathing trumpet [fig.4] is like

Culex, the plane of the margin being about at right angles with the long axis of the tube. On the dorsum of thorax is a pair of short forked hairs just caudad of the trumpet; on the metathorax is a transverse row of slender setae, and caudad of the base of the posterior margin of the wing are five or six rather long setae. The two stellate hairs on the first abdominal segment are very conspicuous. The rest of the segments each with a few subdorsal hairs; on the posterior end of the lateral margin of segments 4, 5 and 6 is a single long one, and on 7 and 8 a conspicuous fan of hairs [fig.5]. The swimming paddles are rather small and with cilia on posterior margin. The thorax in mature specimens is dark brown, the abdomen paler.

Described from specimens kindly furnished by Prof. John B. Smith.

Genus URANOTAENIA Arribalzaga

This genus possesses in most respects the same characteristics as Culex and Aedes; it differs from Culex however in having short palpi in both sexes, agreeing in this with Aedes, but differs from the latter in having violet blue scales on the thorax. The palpi of both sexes are two jointed, the basal joint globular, nearly as large as the basal joint of the antennae, the apical joint small, conical and pointed; differing thus from the cylindric palpi of the female Culex.

Uranotaenia sapphirina Osten Sacken (Aedes)

Plate 46, fig. 8-15

Am. Ent. Soc. Trans. 2:47

"Wings unspotted; abdomen dorsally brownish, thorax tawny brown with a median dorsal, and three lines on the pleurae, metallic blue; tarsi brownish, unbanded." Description of Osten Sacken. 1868. 2:47. "Fuscous, the frons, a median thoracic line and stripes on pleurae metallic blue; bases of coxae and femora pale; apexes of the femora and tibiae snowy. Front blackish, with a metallic blue reflection along the eyes, specially in the middle. Antennae blackish, scapus tawny; those of the male apparently 15 jointed (13 plus two), flagellum with 12 beautifully bearded joints; a 13th elongated, linear joint has some scattered hairs, but no beard like the preceding ones. Proboscis long, reaching in the male if bent backward, to about the middle of the abdomen; rather conspicuously incrassated at the tip; perhaps still longer in the female (abdomen of my female injured); thorax brownish, tawny, darker above, paler on the pleurae; a metallic blue longitudinal line along the middle of the thorax reaches the scutellum; three similar marks on the pleurae, the upper of which is in the shape of a short line run-

ning from base of wing toward the head. Abdomen brownish above, paler below; knob of halteres brown, stem pale. Feet brownish paler at the base; a snow-white dot on the upper side of tip of femora and of tibiae; when looked at very obliquely, these white dots appear slightly pale bluish, and the tibiae and tarsi likewise show a faint bluish reflection. Wings clothed with brown scales, but showing in an oblique light numerous blue reflections, especially a stripe near the basis between the third and fourth longitudinal veins. Obs.—In female specimen the scales are rubbed on the feet; therefore appear pale tawny; still, white dots are distinctly visible. Length 3mm. Wing 3mm. Habitat United States, Washington D. C., Brooklyn N. Y."

To the above I may add that in well preserved specimens the abdomen has a very narrow, pale posterior margin, and that the female also possesses the white spot at the tip of the femora, rather faint, and at tip of tibia very distinct. The tarsal claws of both male and female are simple, the middle tarsi of the male with but a single large strongly curved claw [fig.15]. The claws of the hind legs small and but slightly curved. Wing venation as in the figures [fig.13 female, fig.14 male]. The hypopygium of the male, moderate sized with the jointed appendage slender and curved up at the tip [fig.12]; its ventral tooth simple.

[Pl.46, fig.8-15]. The larva and pupa, and the life history of this species are described by Dr Dyar.[1] According to the figures and description given by Dr Dyar, this species differs from the known members of the genus Culex in the following particulars: "Antennae moderate, divergent [fig.10]. The hairs of the thorax and abdomen [fig.8] black, the thoracic ones equal, long; those of the first and second abdominal segment also long; but the rest very short and inconspicuous, stellate. The lateral comb [fig.9] of the eighth abdominal segment is a large plate with a row of stout teeth on the posterior edge . . . air tube rather short, not longer than two segments, widened at the tip by four distinct, flattened teeth, as long as the width of the tube; last segment moderate, with the usual four anal fingers (blood gills). Pupa essentially as in Culex. . . Segments dorsally

[1] N. Y. Ent. Soc. Jour. 1901. 9:179.

tufted with stellate hairs and some small tufts about the eyes and between the prothoracic air tubes. Tubes long, slender, uniform in width, not flared, but slightly bent in the middle, about 12 times as long as wide."

Family DIXIDAE

Dixa midges

Plate 48

These little flies closely resemble mosquitos in size and form; but may easily be distinguished from them by the venation of their wings, and in that the veins are not furnished with scales [pl.48, fig.8]. The antennae are about 15 jointed, and differ but slightly in the two sexes; the legs are long and slender; and the caudal end of the abdomen of the male is enlarged. The family includes only a single genus, Dixa. The flies appear to be rare in America; at any rate are rarely observed.

The larvae of several European species are known. The following is the first published description of the larva of an American species, as far as I am aware.

Dixa modesta nov. sp.

Mr Henshaw kindly compared this species with Loew's types in the Cambridge Museum and he found that it differs from all of them.

Male and female. Brown, dorsum of the thorax between the dark stripes yellowish; scutellum, middle and hind coxae, and tip of the abdomen either yellowish or pale brown. Length 2 to 2.5 mm.

Head dark brown, including palpi, antennae, and proboscis. Thorax including the pleura, metanotum, and sternum, brown; dorsum yellow with three wide brown stripes, scutellum yellowish or pale brown. Abdomen dark brown or black, venter a little paler, last segment yellowish, tip of genitalia black. Legs brown, middle and hind coxae yellowish, and the basal portion of the femora more or less yellowish brown, the tarsi and the tips of the tibiae almost black. Wings hyaline very faintly cinereous, veins fuscous, cross vein not clouded; the peduncle of the Cubitus about as long or but little longer than the fork. Venation as shown in figure 10.

Described from a number of captured and bred specimens. April and October 1902. Ithaca N. Y.

Larva. The larva is found in pond water or in slow flowing streams. It is almost always bent double in the shape of a letter U [fig.5], so that the head and tail come close together; the bend being at the sixth segment. When kept in a tumbler of water, it will lie on the side of the glass with its body above the water level; its head and tail toward the water. It appears however that it is still within the surface film. Its general color is a pale fuscous with black head and appendages. The body consists of three thoracic and eight abdominal plus the anal segment. The head [fig.1] is somewhat quadrangular in shape, with the antennae at the anterior lateral margins. On the dorsal head sclerite are three pairs of setae arranged as in figure 6; and on the ventral surface are also three pairs besides a smaller one at the base of each antenna, as shown in figure 1. The antennae are slender, slightly curved, and deep brown in color, with numerous sharp, distad projecting tubercles or spines. The labrum is attached to the cephalic margin of the dorsal sclerite [fig.6] and hangs flaplike over the mouth. The margin is heavily fringed with dense tufts of hair which appear to act as rotatory organs. Ventrad of this are the mandibles [fig.2], short and stout, each with a curved spine at its cephalic end, a pair of curved setae on its outer (lateral) margin, and a row of fine, curved hairs overhanging the two short, sharp teeth in its inner (mesal) margin. The maxillae are ventrad of the mandibles, and are well developed. At the apical end of each are a few fine, curved hairs [fig.3], and on its outer surface are short, scattered hairs. Its palpus [fig.3*p*] greatly resembles the antenna, but is a little smaller. On its basal joint is a stout seta. The labium is semicircular in outline, with hairs on its apical margin, but apparently without teeth.

On the dorsal surface of the first thoracic segment are a few long, cephalad projecting setae, and a few shorter ones on each of the following thoracic and abdominal segments. The first two abdominal segments each have anteriorly on the ventral surface a pair of short prolegs with rows of short, curved bristles [fig.5*c*]. The ventral posterior margin of each of the eighth, ninth, and tenth body segments (fifth, sixth and seventh abdominal segments) is a fringe of stout caudad projecting bristles [fig.5*b*].

The appendages of the last segment of the abdomen superficially resemble those of Anopheles. The spiracles open on the dorsal surface [fig.7*s*], and surrounding each of these and extending laterad is a leaflike plate with a ciliated margin. Immediately cephalad of these is a transverse row of six short branched hairs. Extending caudad are two long, dark brown

fingerlike lobes, each with a marginal fringe composed of a single row of stout setae; and lying between these is a third, cylindric, nearly black in color, provided apically with three pairs of long black setae, and a short, pale yellow terminal joint [fig.7]. The middle lobe does not extend quite so far caudad as do the lateral lobes, differing in this respect from the described (European) species. It is a little more than twice as long as wide. Of the four small respiratory gills figured by Meinert in *De cucephale Myggelarver* nothing is to be seen in the specimen from which the drawing was made, though they are present in specimens discovered later. Caudad of the spiracles and lying on the dorsal surface is a triangular chitinized plate, the rounded vertex pointing cephalad, the basal angles each provided with a single short seta [fig.7*p*]. On the ventral surface, at the base of each of the long lateral lobes, is a short, semicircular lobe with a marginal row of short, black spines [fig.5*a*]. On each side of the middle line and caudad of the small lobes is a black ridge or keel with two black setae, the longer one projecting caudad, the shorter one projecting laterad; and extending transversely between the bases of these setae is a matted fringe of fine, pale yellow caudad projecting hairs.

Pupa. The pupa [fig. 4] is pale fuscous. The single observed specimen assumed a nearly circular position, its caudal end nearly touching its head, and remaining motionless on the side of the glass above the water film. Normally a Dixa pupa rests on its side, and according to Meinert it may thrive either in or out of water. The length of pupal life is about three days. No setae were observed on any portion of its body. The breathing trumpets are short, with widely flaring conical mouths. There are eight abdominal segments besides the anal one. The anal segment has two long, pointed lobes with very finely serrate margin and a few short, terminal hairs.

The larva on which this description is based, was found in Ithaca N. Y. in a slow flowing stream Ap. 11, 1902; it pupated Ap. 18, and emerged three days later. A number of specimens were found in October.

KEY TO SPECIES OF DIXA

In order to facilitate identification, the following key is offered, which must however be used with caution, as it is in part compiled from descriptions.

1 Species having both the proboscis and the scutellum yellow.....(2)
Having either proboscis or scutellum black.....(4)

2 Knob of the halteres black. With the head, palpi, base of the antennae, thorax, venter and the legs except the tip of the femora, yellow. Length 2.7mm. Berl. Ent. Zeit. 1863. Centur. 3, p.1. District of Columbia.....marginata Loew

Knob of the halteres yellow. With the head, antennae, palpi (except the base), thoracic stripes and part of the legs brown or black.....(3)

3 Cross vein with cloud. "The peduncle of veins R_1 and R_2 very short." Female. Length 2.7mm. Berl. Ent. Zeit. 1863. Centur. 3, p.4. Maryland and New Jersey (Johnson) .....notata Loew

Cross vein not clouded. Peduncle of this vein as usual; a little shorter in the male than in female. Length 2.5mm. Berl. Ent. Zeit. 1863. Centur. 3, p.3. New York and Ithaca N. Y. (=? D. recens Walker).....terna Loew

4 Species having both the proboscis and the knob of the halteres black .....(5)

Having proboscis and halteres of different colors.....(6)

5 Thorax with yellow space between the dark dorsal stripes. Ithaca N. Y.....modesta n. sp.

Without yellow on dorsum. Blackish species. Lower part of the pleura, sometimes scutellum and metanotum, coxae and base of the femora, and stem of the halteres yellow. Male and female. Length 2.5 mm. Berl. Ent. Zeit. 1863. Centur. 3, p.5. New York.....fusca Loew

6 With yellow rostrum; halteres with a fuscous head. Head, palpi, antennae, thoracic and pleural stripe, abdomen and tip of femora wholly black; tarsi fuscous. Length 3 mm. Male. Berl. Ent. Zeit. 1872. Centur. 10, p.1. Texas.venosa Loew

With black proboscis; halteres yellowish; palpi and proboscis and tips of femora and tibia black.....(7)

7 Antennae and scutellum black; pleura and metanotum black; and tarsi and abdomen fuscous black; halteres sordidly yellow. Male 2.7 mm. Berl. Ent. Ziet. 1863. Centur. 3, p.3. New York, (=D. nova Walker?).....centralis Loew

Antennae yellow at the base, flagellum pale fuscous, scutellum fuscous testaceous; tip of posterior tibiae thickened. Metanotum black with yellow margin; abdomen shining cinereous black; tarsi black toward the tip. Male and female. Length 4.2 mm. Berl. Ent. Zeit. 1869. Centur. 8, p.1. Massachusetts .....clavata Loew

Family CHIRONOMIDAE

This family is exceedingly rich in species. Owing to the fact that the life history of comparatively few is known, it is difficult to give a key even to the genera of the larvae and pupae. The Chironomidae may be divided into three groups, the first

containing Chironomus and allied genera, the second containing Tanypus and some others, and the third, Ceratopogon etc. Besides this, there are a few aberrant genera which can not well be placed in any of the above mentioned groups.

The bibliography of the biologic literature is rather extensive, specially for European species; and I will therefore give only that which may be of particular interest to the American reader.

Brauer, F. Syst. Studien auf Grundlage der Dipteren-Larven nebst einer Zusammenstellung von Beispielen aus der Literatur ueber dieselben und Beschreibungen neuer Formen. Denkschr. d. k. zoo. bot. Gesell. Wien. 1883. 47:1-100, pl.1-5

Fries. Monographia Tanyporum Sueciae. 1824

Gercke. Verh. Ver. Hamburg. 1877. 4:6, and 1880. v. 6

Kieffer, J. J. Allgemeine Zeitsch. f. Ent. Aug. 1901. Ceratopogon and Wulpiella

Meinert, Fr. De eucephale Muggelarver. With extensive bibliography. 1886

Miall & Hammond. The Harlequin Fly. On the Life History and Anatomy of Chironomus dorsalis. With bibliography. 1901

Packard, A. S. On Insects Inhabiting Salt Water. Am. Jour. Sci. no. 2. 1871. Species of Ceratopogon (nec Tanypus)

—— Essex Inst. Proc. 6:42. Chironomus oceanicus

Pettit, R. H. Mich. Acad. Sci. 1900. p.110. A Leaf-mining Chironomus

Osborn, H. Iowa Exp. Sta. Bul. 32. Chironomus Larva

Smith, Sidney. United States Fish. Com. v.2, Rep't for 1872 and 1873. Sketch of the Invertebrate Fauna of Lake Superior. Larva of Chironomus

The Chironomidae are gnatlike flies of slender form, the males conspicuous for their plumose antennae. They may be distinguished from mosquitos, which they resemble very much, by the costal vein not being continuous on the posterior side of the wing. The larvae are soft skinned, wormlike, and usually aquatic, though some are terrestrial. These midges are often seen, specially in the early spring or in the autumn, in immense swarms, dancing in the air. For a more complete characterization of the family the reader is referred to Comstock's *Manual for the Study of Insects* or to Williston's *Manual of the North American Diptera.*

Gercke, in *Verh. Ver. Hamburg*, 1878, 4:225, distinguishes the larvae of Chironomus and Tanypus thus: "All Chironomus larvae have a cylindrical body, a short oval head; the smaller spe-

cies yellowish in color, often colorless; the larger ones often a deep red. All Chironomus larvae build a cylindrical, gelatinous, or silky case, in which they usually are hidden. The larvae of Tanypus possess a distinctly segmented, somewhat flattened body, with long conical anal prolegs, an elongate triangular head, with distinct eye spots. They do not appear to build a larval case." Those Ceratopogon which in the adult state do not possess hairy wings, have aquatic larvae. These are very elongate, snakelike in form, with a conical head, no thoracic or caudal appendages, save sometimes a few bristles at the tip of the last segment.

The pupa of Chironomus usually lies hidden in the larval case, keeping the water surrounding it in circulation by the undulating motion of the abdomen. The pupa of Tanypus is active and resembles that of Culex. The pupa of Ceratopogon is more elongate than that of Tanypus, and is not active, but floats nearly motionless, with its body in a vertical position.

For determining the genera of the imagos, the table given by Williston in his *Manual of the North American Diptera* is most useful.

Chironomus (sens. str.) sp.

Plate 49

A large number of larvae and pupae were taken from the stomachs of brook trout, as has been described by Professor Needham in this bulletin. Many specimens were examined and all found to belong to the same species. The species evidently being of great importance as fish food, it is desirable that it may in the future be recognized, and therefore I herewith describe it. Many characters here given apply to the genus as well.

Body slender, 12 segmented, full grown specimens about 18mm in length. Occasionally, still living specimens were found within the fish stomachs; these possessed the brilliant red color so characteristic of certain Chironomid larvae. At the anterior end of the first segment and at the posterior end of the 12th are pairs of prolegs. The head is small, dark brown, heavily chitinized, a little longer than wide. The sclerites of the head consist of a dorsal, ventral and two lateral plates, besides a number of smaller ones. The dorsal sclerite resembles that shown on plate 50, figure 4; but there are three pairs of bristles

near the suture on the dorsal plate, the anterior pair quite close to the anterior margin [pl. 49, fig.8], and laterad of the posterior pair, lying close to the suture, but on the lateral plate is another seta. The median plate carries the labrum [*lr*, fig.8], which hangs flaplike in front of the mouth and may be bent backward, and on its under surface are three pairs of setae. Attached to the labrum on its ventral surface is the epipharynx [fig.3*e*]. This is a complex structure attached at its anterior margin, its free margin projecting ventrad and caudad. On its surface are a number of spines, its margin is serrate and provided with three pairs of small serrate teeth. In addition to this is a pair of long, chitinized, sickle-shaped processes. The shape and the arrangement of the setae are as shown in figure 3. The lateral plates bear two pairs of rudimentary eyes (pigment spots), as well as the antennae and the jaws. The antennae [fig.2] are situated on the anterior end of the lateral plates; they are small, consisting of a comparatively long basal joint, on which are two terminal pieces, one four jointed, the other somewhat shorter and simple. The mandibles, situated ventrad of the antennae are stout and with a four or five toothed apical margin. Near the base, overhanging the teeth, is a brush of hair [fig.6 and fig.8*m*]. The mandibles are articulated in such a manner that they move in an oblique plane, striking the labium [fig.8*l* and fig.5*l*]. The labium is attached, or rather coalescent with the front margin of the ventral sclerite of the head, the suture separating this sclerite from the lateral ones only faintly marked. Miall & Hammond consider the ventral piece as a portion of the lateral sclerite. The margin of the labium is toothed, the three middle teeth somewhat shorter than those immediately laterad of them [fig.5*l*]. Near the base and ventrad of the mandibles are the maxillae, consisting of fleshy processes, with forward projecting teeth on the lateral margin; a bunch of slender lobes and setae on the inner margin; and a short stout palpus with some terminal spines and papiliae [fig.5*mx* and fig.9]. On the ventral surface is a long stout seta. On each side of the labium is a striated and flexible fan-shaped flap which helps to close in the mouth [fig.5]. On the floor of the mouth cavity, lying close to the labium, is the hypopharynx. Its anterior margin is furnished with a number of short spines and bulb and platelike projections. This is the piece which Miall & Hammond, in their work on *The Harlequin Fly*, on page 29, call the upper plate of the labium, or mentum in the figure on page 30. Its function seems to be that of a guide for the silk thread, as is undoubtedly the case with Simulium. The prothoracic pair of feet [fig.4] are furnished with a large number of slender curved hairs, yellowish in color, the two feet

very close together so that they appear as one. The first three segments in specimens which are ready to transform are enlarged and represent the thorax; the intermediate segments are subequal in length and apparently without trace of setae. On the ventral surface of the 11th are two pairs of long blood gills [fig.7], on the caudal end of the dorsal aspect of the last segment are two tufts of five or six long hairs; ventrad of which is a bunch of four very short processes. The anal feet are about as long as the 11th segment, each one with a crown of 12 to 15 bifid claws, resembling the one shown on plate 50, figure 9, but sharper, straighter and more slender, and the inner one comparatively shorter, the angle between the two teeth being about 60°.

The pupa [fig.12] is elongate, its abdomen eight segmented, not counting the anal appendage. The usual respiratory filaments of Chironomus, consist of a pair of much branched tufts. On the lateral margins of each of the segments are a few delicate, transparent filaments [fig.10]; of these there are five pairs on the eighth segment, besides a pair of chitinized toothed claws. On the margin of the anal segment is a close row of hairs, the basal portions of which are stout, but extremely fine at the extremity, where they become matted, forming a paddle [fig.10, 12].

Of course no adults were found in the material, but from some nearly mature pupae the flies were withdrawn, and these possess the following characters. Length, 7 to 8 mm. Dorsum of thorax brown, with the usual three dark dorsal stripes; pectus darker brown; dorsum of abdomen paler brown, the incisures whitish; the ventral surface of each segment with a large, rectangular brown spot, the rest whitish; legs yellowish brown; the tips of all joints blackish. Metatarsus longer than the preceding joint; all tarsal claws simple. Male genitalia complex, consisting of two pairs of blunt lobes, the outer pair the longer; a pair of two jointed claws; and on the dorsal aspect is a single large, heavily chitinized, downward curved hook. Figure 11 shows a side view, the dorsal surface being turned uppermost. The colors given in the above description are doubtless intensified in the living fly. It is hoped that by means of this description the fly may later be recognized.

THALASSOMYIA Schiner

Plate 50, fig.1-15

Verh. Zool. Bot. Ver. 6:216, 1856

This is the first record of the genus from North America. As far as I am aware, but two species have been described, T. frauenfeldi Schiner and T. congregata Tomasovary,

both European species. The genus belongs to the group Chironomus (*sens. lat.*); but differs from all the other genera of this group in having the fourth tarsal joint shorter than the fifth [fig.14], resembling in this respect Tanypus, and Diamesa, from which it differs in the wing venation; the R–M cross vein wanting; antennae as in Chironomus.

T. obscura n. sp.

This fly was very common here during the past summer, the larva living on the rocky bottom of the shallow, swiftly flowing streams, where the water is but an inch or two in depth [pl.32], sometimes in company with Simulium; it spins a loose cocoon so open and transparent that the larva is not hidden by it, though it prevents the larva from being washed away.

Male. Front and epistome yellow, palpi fuscous, shorter than the antennae, its first joint about one and one half times as long as broad, the second twice, the third three times and the fourth about four times as long as the first. Antennae fuscous, 14 jointed, the first disklike, the second longer than broad, the third to the 13th about as long as broad, the 14th longer than all the others taken together; all furnished with long brown hairs except the apical one fourth of the 14th. Dorsum of the thorax blackish. Yellow on the humeri and pleura, covered with a white bloom, most conspicuous on the humeri. The dorsum of the thorax has a dirty yellow ground color but the three black longitudinal stripes are so wide that only a little of the ground color shows, excepting on the humeri and the two very narrow faint longitudinal stripes separating the three wide, black ones. The scutellum is chestnut; metathorax black; pectus brown; abdomen dull black, the dorsum of the first two segments greenish; the extreme edge of each segment, paler fuscous; the venter greenish, darker, almost black on the more posterior segments. The green is sharply separated from the dorsal color on a lateral line. In dried specimens this green color becomes dusky. Legs almost black, the coxae and bases of the femora yellowish, tarsal claws simple; wings hyaline, hairless, the anterior veins yellowish, the rest hyaline; venation as in the figure; anterior and posterior margin delicately ciliate; genitalia inconspicuous [fig.13, dorsal view]. Halteres white. Length 3 to 5 mm.

Female. Antennae seven jointed, black, with short hairs. Thorax with the black stripes a little narrower than in the male,

hence the yellow stripes separating them and those on the humeri, more conspicuous. Pectus, scutellum, and a little space in front of the latter, brown; the pectus in dried specimens sometimes nearly black; pleura yellow, metanotum black; abdomen as with the male, but the venter paler, legs black, coxae and base of femora yellow; tarsal claws simple; wings hyaline, anterior margin and tip a little smoky; anterior veins yellow; wing margins delicately ciliate; venation as with the male; halteres white. Length 3 to 5 mm.

Larva. The eggs I did not find. The larva is 8 to 10mm in length when full grown, pale or yellowish green in color, its head dark brown and heavily chitinized. The head is somewhat longer than wide, the dorsal suture well marked, and with a few setae arranged as in figure 4. Two setae are placed immediately in front of the transverse suture, and at the apical end of the labrum are two more [fig.4]. A ventral view of the labrum is given in figure 3; *c* representing the epipharynx to which perhaps belongs also the two lateral pieces with their pointed processes. The anterior margin is furnished with a number of small fleshy lobes. The antennae are small, the basal joints about four times as long as wide, with two terminal pieces, one of which is four jointed, the other simple [fig.1]. The mandibles [fig.2] are about twice as long as broad, heavily chitinized, and with five short, blunt terminal teeth; articulated at the base of each is a long slender piece, with four terminal spines. This is shown folded down in the figure. The maxillae are short protuberances, covered with pointed processes; a very short palpus with terminal papillae, and two stout setae projecting ventrad. The hypopharynx [fig.5] is tonguelike, with two long basal pieces. Its apex and its dorsal surface are covered with pointed papillae; ventrally, there is an open arched rib. At the cephalic end of the ventral sclerite and coalescent with it, is the labium, with 11 blunt marginal teeth, the middle one wide and broadly truncated. On the prothoracic segment are the two prolegs, each with about 30 long, curved spines, and a number of small and very short spines on the ventral surface. At the base is a single slender seta, on each side a little dorsad of the lateral line are two more, and caudad of these and below the lateral line a group of three. The 11th segment is without blood gills; the 12th with two comparatively short legs, each with a crown of eight to 10 bifid claws [fig.9, 12]; dorsad of which are two tufts of five or six bristles each. Between the prolegs and projecting caudad are four short blood gills.

Pupa. The pupa is about 4½mm long, with the colors of the adult. It is much shorter in comparison to its breadth than that of Chironomus (*sens. str.*). The wings extend to little beyond

the posterior margin of the second abdominal segment. Eight segments are present besides the short anal segment. On the dorsum of each segment, toward the caudal margin, is a transverse band of stout, black bristles. Each band is composed of five or six rows. The arrangement of these bristles (the longest of which are about one third as long as an abdominal segment) is shown in figure 11. The anal segment is composed of two lobes with a single apical bristle. After two to four days of pupal life, it transforms into the adult.

Genus DIAMESA Meigen

This genus has long been known to occur in Greenland, but has not, till now, been recorded from the United States. In 1898, Lundbeck described three new species from Greenland, one of which, D. aberrata, he considers the species which Staeger erroneously (?) identified as D. waltlii.

Antennae of the female eight jointed, the basal disklike, the intermediate ones rounded, the last cylindrical. Antennae of the males usually plumose and 14 jointed. Eyes oval; the front wide and flat. The eyes and the wings resemble Tanypus. The cell M is separated from the cell M_{1+2+3} by a cross vein, as in Tanypus. The fourth tarsal joint is shorter than the fifth.

Diamesa Waltlii Meigen

1838 D. waltlii Meigen, Syst. Beschr. 7:13, 1

1846 nivoriundus Fitch (Chironomus), Winter Insects of Eastern New York nec Orthocladius nivoriundus Johnson, (?) Cat. of New Jersey Diptera

This fly occurs, sometimes abundantly, in this State from January to April. Fitch's description is rather indeterminate, but I believe it to belong to the species which is described below. I have compared it with specimens from Europe, with which it agrees in all particulars. According to Lundbeck [*Diptera Groelandica*, 1898], D. Waltlii does not possess cilia on the posterior margin of the wing, he quoting Meigen as authority; the European specimens which I have do have these cilia, as do also the American specimens; and I therefore believe that aberrata Lundbeck is also a synonym.

Male. Black. Head black, including eyes, mouth parts and antennae, the latter densely covered with long, dark brown hair. Its first joint enlarged, disklike, the second twice as long as broad, the following 11 a little shorter than broad, the 14th

longer than all the rest taken together. The palpi are somewhat shorter than the antennae, four jointed (besides a small basal piece), the first joint shorter, the fourth longer than the other two. Dorsum of the thorax black, subshining, with a faint cinereous bloom, covering the surface excepting the three slightly raised longitudinal stripes, which are deep black, and on which are arranged some scattered black setae; scutellum dark brown, with black setae; metanotum and pleura black, the latter with a gray bloom; abdomen black, longer than the wings in fresh specimens, covered with fine brown or black hairs, posterior margins of the segments narrowly cinereous.

Genitalia conspicuous and rather complex [pl.47, fig.8 dorsal, fig.10 ventral, view]. The apical joint of the appendages, triangular in outline with a sharp point; the basal joint with a pointed process attached near its base on the inner side, mesad of which are two smaller pointed projections. The dorsal spur is nearly straight and spikelike. Legs uniformly fuscous, all the fourth tarsal joints shorter than the fifth, tarsal claws simple. Wings broad, and nearly as long as the abdomen in fresh specimens; usually longer than abdomen in dried specimens; cinereous in color, the anterior veins conspicuous, brownish or black; media and cubitus pale, posterior margin very delicately ciliate. Halteres usually pale, in some specimens pale brownish, the knob triangular in outline. Length 3.5 to 5mm.

Female. Cinereous black, front and epistome cinereous, eyes but slightly excavated at base of antennae; palpi and antennae fuscous, the latter with eight joints counting the disklike basal joint, short haired [fig.7]; scutellum hemispherical, dark brown, with black setae; abdomen fuscous with short brown hairs, posterior margin of the segments darker except on the extreme edge, which is pale yellow; genitalia small, brown and leaflike; legs fuscous; claws simple; wings broad, and longer than the abdomen; anterior veins black; media and cubitus pale; venation as in the figure. Length 3.5 to 5 mm. All else as with the male. Described from bred and captured specimens.

Larva [pl.48, fig.9–13]. The larvae were taken in company with the larvae of Thalassomyia fusca among the algae on the surface of rocks over which the water flows rapidly. In its pale green color, its general appearance, and even in many details it greatly resembles Thalassomyia fusca. The dorsal sclerite of the head is shaped like that of the last mentioned species shown on plate 50, figure 4; with two pair of marginal setae, but the hindmost pair are situated farther back than in Thalassomyia fusca. On the lateral sclerite there is one seta near the base of the

mandible just above the lateral line, one pair below this one and a little cephalad; another pair about one fourth of the length of the head caudad of these but lying as far below the lateral line as the first is above. Directly caudad of the first, but midway between the front and hind margin of the head, is another. Close to the dorsal suture, one fourth the length of the head cephalad of the caudal margin, is still another; and finally there is a single one on each side at the base of the labium [fig.10].

The ventral surface of the labrum is shown in figure 9. The hypopharynx resembles that shown in plate 50, figure 5; and the maxilla that shown in figure 6. The epipharynx is as shown on plate 48, figure 9*c*, its free end having four to six filaments, the apical pair being stoutest. This member may be bent forward and the filaments then spread out, fanlike. The "jointed appendages" [fig.9*j*] are well developed; each is apically expanded into a handlike process with seven or eight "fingers." These appendages are attached at a point near the anterior margin of the labrum. The mandibles [fig.12] have each five blunt teeth, a fringe of coarse branched hairs projecting mesad, and two stout setae on the dorsal surface near the base. The labium [fig.10] possesses about 19 blunt teeth, no suture being visible between it and the lateral (or ventral?) sclerite. The antennae are of moderate length [fig.11] and bare, with three terminal, jointed appendages. The thoracic and abdominal feet are as on plate 50, figures 7 and 12; but the abdominal legs appear a little longer in proportion to their diameter. The entire body of the larva is almost devoid of hairs excepting the caudal tuft.

Pupa [fig.13]. The pupa is of a fuscous color with a greenish tinge; its thorax is apparently without either tracheal gills or breathing tube. On the dorsal posterior margins of each of the abdominal segments excepting the first and last there are 10 to 12 short, stout, caudad projecting teeth, the two or three lying nearest the lateral margin being smaller than those more dorsad; and on the ventral posterior margin of the abdominal segments excepting the first, second and last there are six or eight stout teeth projecting cephalad. At the anal end of the last segment are three pairs of short hollow filaments, which may have a respiratory function. The length of pupal life is about two days.

This pupa greatly resembles that of D i a m e s a c u l i c o i d e s as figured by Heeger in Sitzb. d. k. Akad. d. Wiss. Wien., 1853, excepting that in the latter there are eight caudal filaments instead of six.

Described from specimens taken in Cascadilla creek, Ithaca N. Y., April 1902.